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CONTENTS

FEBRUARY 1943

Ordnance Automotive Experience in This War
- Major-Gen. Levin H. Campbell, Jr. 21

Cooperation of Vehicle Manufacturers in Army Maintenance Program
- Brig.-Gen. James Kirk 23

American Technicians Top Axis Results, SAE War Engineering Meeting Hears 28

SAE Officers for 1943 - - - - - - - - - - - - - - - - - 35

Reports of SAE Committees - - - - - - - - - - - - - - - 41

TRANSACTIONS SECTION

Requirements for Carburetor Air Filters for Aircraft Engines
- Wayne D. Cannon 33

New Methods for the Evaluation and Recording of Piston-Skirt Deposits
- H. R. Luck, T. A. Rogers, and A. G. Cattaneo 38

Cooperative Research Comes of Age - - - - - - - - - C. B. Veal 45

Correlation of Laboratory Oil Bench Tests with Full-Scale Engine Tests
- C. W. Georgi 52

Reconditioning Cylinder Blocks and Fitting Sleeves - - - - - - - - - 49

About SAE Members - - - - - - - - - - - - - - - - - - 52

Engineering Display - - - - - - - - - - - - - - - - - - 77

News of the Society - - - - - - - - - - - - - - - - - - 81

SAE Coming Events - - - - - - - - - - - - - - - - - - 84

Applications Received - - - - - - - - - - - - - - - - - 84

New Members Qualified - - - - - - - - - - - - - - - - - 88

A SECOND FRONT FOR *Soldiers in Overalls*

SOLDIERS in overalls, building weapons for our fighting men, are fighting this war on the production front. But there is an equally important *second front* of civilian war activity.

On this second front other soldiers in overalls—American service mechanics — must keep buses, trucks and passenger cars on the job, hauling men and materials to their assigned destinations.

Realizing the importance of this automotive service job, Bendix looks upon the production of needed service parts and materials as an essential part of its over-all war-time assignments.

In addition, Bendix furnishes valuable "Know How" manuals to the soldiers of this civilian second front. Books that help servicemen, new recruits or seasoned veterans, make fewer repair parts do a better job for Victory.

Bendix considers it a responsibility and a privilege to stand by the automotive service trade in its great responsibility to keep American transportation rolling.

Products of this Division are vital members of "The Invisible Crew" . . . precision instruments, and controls, which 25 Bendix plants from coast to coast are speeding to our fighting crews on world battle fronts.

BENDIX PRODUCTS DIVISION

THE INVISIBLE CREW

Precision Equipment by Bendix AVIATION CORPORATION

ORDNANCE AUTOMOTIVE EXPERIENCE in THIS WAR

★

by MAJOR-GEN. LEVIN H. CAMPBELL, JR.

Chief of Ordnance, U. S. Army

ORDNANCE feels very close to you of the automotive industry.

That part of the Ordnance load being carried by the automotive industry is indeed a very sizable percentage of the whole. One great source of gratification to us in Ordnance is the fact that you have so widely subcontracted among the small business institutions of this country. By this means you have done much to foster and keep alive the small shop which is representative of small independent business in this great country. With your help and with the help of others, Ordnance takes pride in knowing it has done more than any other one agency of the Government to help small business effectively. We will continue so to do.

By the formation and operation of our machine-tool panels in our Ordnance Districts we have brought into our family of manufacturers a large number of small machine and equipment shops. This has made possible immediate use of available machine tools and other items of manufacturing equipment. Large industries have, of course, placed much of their manufacturing burdens with small plants in the form of subcontracts, as is their usual commercial custom. The war has greatly increased the load on small plants.

Another aid to subcontracting among small plants has been the formation of industry integrating committees. These committees, authorized by law, really permit a group of manufacturers making the same ordnance item to form themselves for all practical purposes into one large combine. Thus, if one of the elements of the integrated company is out of balance due to shortage of certain components, the committee at once calls in the small plant subcontractors to bring him into balance. This, as can readily be seen, has greatly aided our output, as well as maintained in business for survival many small independent manufacturers. Thus, procedures based upon sound, tried and proven economic precepts are being followed in Ordnance.

Ordnance some 20 years ago started to decentralize its activities by setting up some 13 districts extending from

[This address was presented at the SAE War Engineering Production Meeting (Annual Meeting), Detroit, Mich., Jan. 13, 1943.]

one coast to the other and from the Northern border to the Southern. We thus carried our problems to engineering, science, and industry. In Detroit we find one of these Ordnance District Headquarters, the Chief of which is Brig.-Gen. A. B. Quinton, who is so ably assisted by that outstanding business executive, Oscar Weber, as Deputy Chief.

The work done over those 20 years by the small, devoted band of regular officers and of civilians in the districts has played a very great part in the fact that the Ordnance Department now finds itself so very far ahead of where it was at a similar date during World War I. There is just no comparison! We have brought to our side thousands of men from civil life, some of whom at their request have put on the uniform; others have desired to remain as civilians. The choice is always theirs. Our small body of regular officers, but 2.5% of our present total officer strength, has been practically engulfed in this large influx from civil life. These men are engineers covering all lines of engineering endeavor; these are production men, maintenance men, scientists, statisticians, lawyers, scheduling men, in fact, every classification found in the industrial fabric of our country. Many of them represent the very top of their respective fields, and all are making a real contribution in their patriotic efforts to win this war. They are essentially civilians serving in uniforms – and what a job they are doing!

Not content with taking these men into our organization, we have the closest affiliations with various technical and scientific bodies. We have entire engineering departments of your great firms working with us. We have taken over your proving grounds with your personnel; we have taken over your laboratories and your research bodies. We work in the very closest unison with the National Defense Research Council, the National Inventors Council, the Automotive Council for War Production and other outstanding bodies of the same type. I have on my own personal staff three of the leading business executives in this country – K. T. Keller, Lewis H. Brown, Benjamin Fairless, and, in addition, the man who successfully led the War Industries Board of World War I, Bernard Baruch. Every Ordnance District has its advisory staff reaching into the smaller cities and manufacturing centers of the districts. Each district chief, of course, has his civilian deputy and personal advisory staff.

The Ordnance Department is divided into four great divisions – Research and Development, Industrial Service, Field Service, and Military Training.

The Research and Development Division, under the leading ordnance engineer of the world today, Brig.-Gen. G. M. Barnes, is so well known to you engineers in industry that there is little I can add, but suffice it to say, broadly speaking, that his Division is charged with the responsibility of assuring that our weapons will always remain superior to those of our enemies.

Our Industrial Division, under Major-Gen. T. J. Hayes, has charge of all manufacturing activities, which are conducted almost entirely through our field offices – the Ordnance Districts – in which all contracts are negotiated, and where all inspection and acceptance is conducted in the innumerable plants working with Ordnance.

The Field Service, under Brig.-Gen. H. R. Kutz, provides for the supply and maintenance of all Ordnance equipment of our troops in the field. We have taken a very large number of civilians serving as officers into this activity in an effort to bring the best to be had into supply, warehousing, shipping, salvage and maintenance – another case where we have turned to the civilian strength of our country to augment ourselves. When I tell you that this branch has thousands of officers and enlisted men you can get some idea of the magnitude of this task. We supply and maintain all motor vehicles, as well as all combat vehicles. These combined in a column would surround the earth at the equator. That gives you some idea of the magnitude of the automotive task alone! The largest maintenance task, however, is not found in automotive equipment, but rather in the aggregate of the weapons of all types.

The Military Training Division, commanded by Brig.-Gen. J. S. Hatcher, consists of a large number of training schools for both officers and enlisted men, properly located over the United States and in some foreign theaters. It is of the utmost importance, obviously, to be assured that our officers and enlisted men are trained to that fine degree of skill required to perform successfully the Ordnance functions in this day of highly mechanized warfare. These four generals are leaders, above all; they are tops.

We used to think of ourselves as the Ordnance Department of the Army; later we thought of ourselves as "THE ORDNANCE-INDUSTRY DEPARTMENT," but now we call ourselves "THE INDUSTRY-ORDNANCE DEPARTMENT"! We of the regular service and some of our older reserve officers and civilians furnish the leadership, the rallying ground, the focal point of the Ordnance effort, but the engineering, the research, the productive work is being done by the civilians and civilian institutions of these United States. The total output of our Arsenals is less than 5% of the Ordnance requirements.

One of the most effective operations which the team "INDUSTRY-ORDNANCE" has contributed to the war effort has been in the conservation and substitution of materials. Many of you are, of course, familiar with those booklets "Tremendous Trifles," "Metalurgency" and "Battlenecks" which have such a wide circulation and warm reception. In addition to these booklets, over 15,000 letters have gone out to men in industry urging them to give us their suggestions as to improvement of design, simplification of manufacturing procedure and simplification of specifications. The response has been most heartening, showing the interest of the other half of the team in aiding the war effort. It is nice to know, too, that the Ordnance end of the team has accepted over 60% of the suggestions. Figures are usually tiresome but it is of real interest to you engineers to know that a year ago the armor plate of our medium tank used 617 lb of nickel and now has *36 lb;* that a machine gun had *one lb* and now has *½ lb;* that we have effected an overall savings in the use of chromium of *19%*; in molybdenum of *9%*; in nickel *62%*; in vanadium *74%*; in tungsten of *85%*. I will spare you further details!

As a further example of how our "ORDNANCE-INDUSTRY" team works, it may be of interest to know that most of the large suppliers of automotive equipment have their own service and trouble-shooting men in the combat zones and theaters of operation throughout the world. These experts augment those of the Army and assist very greatly in keeping our equipment in operating condition. Again "INDUSTRY-ORDNANCE"!

A constant goal of our "INDUSTRY-ORDNANCE"

turn to page 27

Cooperation of Vehicle Manufacturers in ARMY MAINTENANCE PROGRAM

by BRIG.-GEN. JAMES KIRK

Chief, Maintenance Branch, Field Service Division
Ordnance Department

HISTORIANS tell us that one big reason for the unity of our vast United States has been the development of our excellent communication and transportation systems. Our ability to get together and talk things over has enabled us to settle our differences amicably, each giving in a little until the right course became clear. Naturally, the right course is the one that is most advantageous to most of the people concerned.

We in the Army realize the tremendous effort, ingenuity, and "know-how" which you in industry have mobilized, in order to produce the huge sum total of war equipment we have received in the past year. When the Army familiarized industry with the specific requirements of military vehicles, you immediately set out to make the necessary changes in your products. Improvements are still being made, and as a result, the Army is getting military vehicles of better and better design.

■ Army-Industry Compromise Successful

What made such rapid progress possible? It would have been much easier for industry to deliver two-wheel-drive vehicles, trucks without winches, or any of the other characteristics peculiar to military vehicles. And it would have been easier for the Army to demand radically different vehicles, specially designed from the ground up. But without going to either of these two extremes, we got *what* we needed *when* we needed it. This is how it was done:

First: the Army familiarized industry with the requirements of military vehicles. We showed industry's engineers that two-wheel traction was not sufficient for the terrain over which military vehicles must operate; that heavier, more rugged construction was required to stand the twists and strains that accompany such operations.

Second: industry and the Army solved these problems together. Industry pointed out that gradual changes would give the Army their vehicles and that eventually they would have not only quantity but military quality, too.

The Army conceded the point of getting an ideal military vehicle and industry conceded the point of simply producing huge amounts of commercial type trucks. The resulting compromise has proved fairly satisfactory.

■ Industry and Maintenance

But does industry's responsibility end with the delivery of these military vehicles? I think not. Production of the vehicles is only half the job, and industry has done that

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Brig.-Gen. James Kirk

half very well. It is vehicle maintenance, the *other* half of the job that is slowing us down, and it is time for industry and the Army to work it out together. The efficiency of our fighting forces depends on how well and how fast we do it.

Think for a moment of the largest fleet of trucks you have ever known any one operator to have. Was it 15,000 or 25,000 trucks? Whatever the number happens to be, your Uncle Sam is operating a fleet today that makes the largest civilian fleet in the land look puny by comparison. And with this huge and formidable fleet of vehicles comes a huge and very formidable *problem of maintenance*. It is a problem that can make or break us in this war of machines.

Our Commander-in-Chief, the President, has recognized the importance of the problem. Back in June, 1942, in a letter to the owners and drivers of America's motor trucks he stressed the vital importance of motor trucks in the war effort. He urged their conservation, as a patriotic duty, to speed the flow of farm, military, and industrial products so necessary to victory.

Now, it is probably not necessary to remind automotive engineers that Army truck and tank maintenance must be better and more complete than is needed for commercial vehicles. Nevertheless, I do want to remind you that while commercial fleets operate, for the most part, over carefully studied routes with veteran drivers, *we* are not so fortunate. We are going to abuse our vehicles. We cannot pick out spots for their operation nor can we pick the type of service or terrain. These vehicles will go where the Japs and Germans are and I can assure you we don't always encounter them on boulevards or super-highways.

Even in rough going we will have to speed the vehicles to catch up with the Italians.

Under these conditions we are bound to abuse our vehicles. Not only is our service more severe, but if the Axis forces can draw a bead on any of our equipment they won't do it any good!

Since our *lives* – not profits – depend upon mobility, the ruinous abuse of our vehicles must be balanced by a brand of maintenance not now in existence on any comparable scale.

You may be wondering why the automotive industry should be greatly concerned about the Army maintenance system. After all, maintenance is definitely the Army's job!

But maintenance of vehicles develops related problems. The answers to these problems are not the only elements of maintenance, but are *definitely maintenance essentials*.

■ What Private Jones Needs

To get a clearer picture of these related problems and to learn why their answers are essential to our maintenance system, let us visualize a newly inducted shoe clerk named Private Jones. He is delegated the job of lubricating a six-ton, 6x6 vehicle. He has a job of maintenance to perform. What does he need to do the job? The first prerequisite for accomplishing his job is knowing what to do and how to do it. *He needs training*. Along with the "what and how," he needs the particular tools and materials. He needs supply. The third thing Private Jones needs is technical information relative to the specific vehicle at hand.

Now multiply Jones by hundreds of thousands and you begin to get a picture of the magnitude of the job.

The Army can furnish these men with the actual teaching, but what do we offer them in the way of maintenance instructions?

It would seem logical that accurate maintenance instructions should come first from the automotive industry. Who can better define sound repair procedures than those who originally built the vehicle? Who can better specify the proper tools or the proper procedures? Who can better decide the method of identifying the various parts of a vehicle? I am sure everyone would agree that the automotive industry is best fitted to make these decisions. *But, which manufacturer are we to follow?* Each manufacturer has made these decisions for us in his own parts lists and maintenance manuals, but he has made them without evidence of consulting other manufacturers, and without consulting the Army. For example, one maintenance manual specifies that the universal-joint drive balls should be replaced with new ones, and gives a procedure for doing the job. Another maintenance manual, describing the same universal joint, emphasizes that the drive balls should never be replaced but that the whole universal joint should be discarded and a new one substituted.

Where does that leave the Army? We are certainly not in a position to say that one company is right and another is wrong. So who is to make the decision? Who is to say that this repair procedure, parts list, or tool list is not perfect from every angle but is the best workable plan *we* can develop?

■ Private Jones Again

Before answering this question let us picture another experience of our former shoe clerk, Private Jones. He now has the job of repairing the air brakes on two different makes of Army vehicles. He reads the maintenance procedure prescribed in the maintenance manual of the first vehicle and proceeds to disassemble and repair its brake system accordingly. The second vehicle is assigned to him and, like a good soldier, he refers to the vehicle's maintenance manual. He notes that the repair procedure for the second vehicle is different from the first one and that the explanation takes only two paragraphs as compared to seven pages for the first vehicle.

When our soldier mechanic starts to work on the brakes of the second vehicle he is both amazed and confused to find that *the brake systems on the two vehicles are identical*. Yes, this is an actual case. A brake system manufactured by one manufacturer is used on two of our vehicles but a *different repair procedure appears in each of the vehicle manufacturer's maintenance manuals*. It is not a question as to which manufacturer's procedure is right or which is wrong. *We want the procedure that will do us the most good and we want it standardized*. How can this be accomplished?

Following each repair procedure in the maintenance manuals, industry has done an excellent job of listing the tools prescribed to carry out the procedure. But again there is evidence of inadequate consultation between industry and the Army. The Army is at fault just as much as industry, but we are not here to place blame. Our task is to correct a situation that can only be corrected by cooperation among all of us.

■ Closer Consultation Needed

The lack of proper consultation between industry and the Army is evidenced by the following facts:

1. The Ordnance Department issues a list of special tools which Army maintenance organizations may carry. These tools are called special because they were designed to do a special job, and because they were designed for a special vehicle. Some of these tools can be adapted universally to all our vehicles in their classes. For example, some ordnance standard tool sets contain a clutch aligning tool which can be used on all of our vehicles. This tool is designed specially for clutch work but not for one specific vehicle. All these tools are identified by Federal Stock Numbers, by which the maintenance organizations may requisition them.

2. On the other hand, each manufacturer lists and illustrates in his maintenance manuals the tools that are required and considered special for his own vehicle. Actually some of these are unnecessary because of Army maintenance procedure together with tools already supplied.

The Ordnance Department maintains a shops and equipment section. The men in this section study the problem of special tools, and as a result of their experiments we have Ordnance special-tool sets, as well as standard tool sets. This sort of information is available to industry for the asking. The Army is ready and willing to assist you in the preparation of tool lists, and to aid in solving any special tool problem a manufacturer may have.

Closely allied with the problem of tools is the fluently cussed inaccessibility of units and parts in both trucks and tanks. This is really a bad situation. I fear for the souls of our soldier mechanics when they shout to the heavens about the blankety-blank so-and-so who never thought how in Hades we're going to get at those spark plugs to get 'em out of that tank engine. And as for simple things like replacement of cylinder-head gaskets or valve adjustments, you practically have to dismantle the vehicle to get the job done.

The cab-over-engine is another splendid example of how to make it tough for the mechanic. You gentlemen can probably enumerate many more, like the hard-to-get-at clutch throw-out bearing or the tank you must take apart to get the engine out. But *no one* can tell how many times that kind of fundamentally unsatisfactory design will stop the movement of a desperately needed load of machine-gun ammunition.

No one knows how many lives will be lost because someone did not do his very utmost in the original design.

Too often the logical, important checks on design and performance are skipped over. We say there is not time!

Too many times the designs flit gaily from drawing board to production without even a respectful bow to the experimental test department.

Far too frequently, the advice of practical service men is not sought to learn whether the contemplated design can be readily serviced, and in the constant compromise, vehicle maintenance is ignored to achieve a certain style. We are now suffering, and suffering heavily, for these ill-begotten methods.

For all of this war – as long as it lasts, let's have no more of expedient designing!

The discipline of minds and stimulation of planning brought about by our tremendous immediate need for the *maintenance of mobility* both in the Army and in civilian life are entirely wholesome. They're good for us and will pay big dividends to your firms in the peacetime to come.

■ Parts-Lists Nomenclature

Another related problem of maintenance that requires the consultation of industry is the question of parts lists.

During the past, Ordnance has developed a Standard Nomenclature List as a method of cataloging and identifying the component parts of guns, vehicles, and tanks. This list was established because, in the manufacture of guns, which was the original Ordnance function, Ordnance had to develop its own names and identification numbers for the parts. As Ordnance grew to include armored vehicles and tanks, it continued to list their parts with standardized names and the Ordnance parts numbers. Recently, Ordnance was given the responsibility of maintaining and supplying the great motor transport fleet. Since under this new organization the same maintenance men will be repairing tanks, wheeled vehicles, and halftracks, our next logical step is to standardize the method of listing and numbering parts.

Why? Picture Private Jones again, who has finally learned the nomenclature of vehicle parts as set forth by the Standard Nomenclature Lists. He is assigned to repair a motor transport vehicle. The repairs call for replacing a certain part which Jones has learned to call a cylinder-block expansion plug. He asks for it by this name and the parts clerk looks it up in the manufacturer's parts list. After much searching through the parts list, the clerk tells Jones that there is no such part. Again confusion reigns. What happened was that the manufacturer who developed the parts list decided to call the cylinder-block expansion plug a *core plug*. Perhaps it should be called a core plug, but the point is: *whatever we call it, we must call it by that name wherever it is mentioned.*

■ Parts Numbers Confuse

The same problem bobs up when we think of parts numbers. In motor transport, there are nearly as many different methods of numbering parts as there are different parts lists. One company numbers its parts according to the *sequence* in which they were *designed*. Another company assigns numbers on the basis of the grouping of *parts*. On top of all this, the field organizations have Ordnance Nomenclature Lists which use the *Army* system of numbering parts. With these various systems in use, think of the poor mechanic and the parts clerk, at work in Australia or some other far-off post, wading through oceans of inconsistent parts lists.

That brings up the question, which system shall we use? Should we expect the automotive industry to switch over to the Army's system of listing and numbering parts, the Standard Nomenclature Lists? Or should the Ordnance Department change its system to conform with industry's? Or perhaps a system that consolidated the good features of both methods can be developed. This is for all of us to work out. It's not the Army's job, nor is it industry's job. *It is our job.*

And now let's cover a matter relating to new vehicle parts supply. I urge as emphatically as I can, that when you have released a new vehicle design for production, some one, some engineer, and also your maintenance man sit down with those who plan the parts production program and help to figure the quantities of spare parts which may be required. Parts mortality experience tables are, of course, your first basis for judgment, but your experimental engineer usually knows the vulnerable parts in advance.

He too, can help by his counsel. There are three things that should be available at one time: the vehicle, the spare parts to maintain it, and the parts list for parts identification. Obviously the parts list should be in the very first vehicle to leave the factory.

■ Maintenance Starts At Factory

And here's another problem!

In spite of all the precautions we can take it seems impossible to eliminate entirely the failure of parts due to faulty design or faulty material. It may be that we will always have this kind of trouble, but you can help to avoid its continuance.

We can start at the factory on the maintenance problem. When a model is being run off in large numbers and reports come in from the field pointing out some "bugs" that are causing the maintenance crew misery, is that not the time to get the Flit gun? Why wait until the inventory is used up to modify the design.

This design handicap exists to some degree throughout the motor vehicle set-up. Performance and production seem to be taking care of themselves without any advice from us. But *I cannot urge too strongly that the designers give more thought to maintenance problems.*

■ Army and Industry Share Blame

It may sound as though the Army is trying to place the blame for these inconsistencies in industry's lap. But this is not true. We in the Army realize that if criticism is called for, the Army is not above reproach.

Industry has a Midas-like wealth of newly discovered technical information. It is the sort of information we need to keep our school instructors, officers, and mechanics up to the minute. Industry has willingly volunteered to keep the Army constantly posted on all such developments. This has been done by sending field representatives out on the road to visit our schools and field organizations. It has been a wonderful aid to our men in the field. But sometimes it has been at great cost in energy and time expended by these field representatives.

Let me tell you of an incident that happened in one of our Southwest Automotive Schools.

A factory representative from one of the national tire organizations stopped at our Automotive School, and after warming the outer office bench awhile, he finally was admitted to the presence of the school Commandant. He offered the school Commandant some new information on tire maintenance. The Commandant readily accepted the offer and arranged for lectures to be given by the tire man to the school instructors. After completing his lectures and answering the instructor's questions, the tire man bade them goodbye and continued on his way.

The next day the school Commandant was confronted with another field representative, also from a national tire organization. The Commandant explained that his instructors had learned all the new information about tires the day before. The second field representative was very disappointed, as he well might be, since he had traveled 2000 miles to get there.

This duplication of expense, time, and energy amounts to sheer waste. I need hardly add that neither you in industry nor we in the Army can afford it. Waste in any form *definitely hampers our war effort.*

The need certainly exists for more efficient coordination between Army maintenance and the factory and field personnel of the vehicle manufacturers. A great deal of splendid work has been accomplished. Nevertheless, lack of coordination has brought about an inefficiency which can only be remedied by laying down a more specific policy.

We need the help of industry in the creation of our standard maintenance and training doctrines; we need the help of industry in the prompt solution of mechanical troubles. Therefore, I believe that our contacts with industry should involve two important phases: First, the setting up of a more effective plan of cooperation in the creation of the doctrines I have just referred to, and second, the creation of an improved procedure in the work of your personnel.

■ United Manufacturers Group Urged

In regard to the first point, it is important that we deal as much as possible with manufacturers of vehicles or components on a *united* basis rather than on an individual-company basis. This has already been accomplished with manufacturers of carburetors and electrical equipment. These manufacturers have gotten together *as a group,* and have made such minor compromises in maintenance procedures and doctrine as seemed appropriate to them. Then, still as a group, they have approached the Maintenance Branch of the Ordnance Department with a previously agreed upon program. This simple procedure has vastly expedited the creation of accurate, comprehensive, and simple maintenance doctrines.

We have also made arrangements with these same groups of manufacturers to give our maintenance units prompt and complete information to correct troubles on specific makes and models of vehicles through the Army's maintenance publications.

We believe that vehicle manufacturers also would be agreeable to similar arrangements, and steps for cooperation on this simplified basis are in progress now.

In regard to field visits of your personnel, I want to make clear that we have no desire unduly to limit them; we think they are well worth while. It is highly important that you keep in touch with field conditions.

I have the feeling that your men can do their best work when our units in the field call upon them, through proper Ordnance channels, to become what I term "finder-outers" to investigate the maintenance problems confronting us. Such visits usually have to do with design failures or defects of a specific make and model of vehicle. Findings are carried back to factory engineers and corrections are normally passed back through Ordnance channels for the enlightenment of all Army maintenance organizations.

Your organizations have men available for such duty, and I believe they can well justify their existence in your firms by conscientious work along this line.

Other field visits of your personnel should probably be funneled through simpler and more clearly defined Army channels than heretofore and we are going to establish specific channels through which they may carry on many worthwhile projects.

■ Course for Factory Fieldmen

Arrangements can be made, through Ordnance channels, to give factory field representatives a two- or three-day Army orientation course, to gain a better understanding of Army organization, Army type vehicles, echelons of maintenance and – *this is very important* – the degree of training of men available for servicing Army vehicles.

This orientation would make these field representatives more useful to the war effort. Understanding the Army's problems, its organization, its types of maintenance, would cause these technical advisers to realize the Army's limitations and capabilities. Their advice, based on this first-hand knowledge of military realities, would almost certainly prove more practical and helpful.

Such an orientation schooling in Army organization and the various types of Army maintenance units, and the conditions under which they must operate in the field, may be arranged also for factory men who are responsible for the development of design, maintenance manuals, parts lists, or tools for the Army.

■ Program Shows Promise

The program we have outlined may help in some degree to alleviate our corrective maintenance and preventive maintenance problems. We are not so naive as to think it is the final solution.

If I have said enough to provoke discussion, I will feel gratified.

There is much to be gained! When one realizes that the 5,000,000 civilian trucks in the United States run up an estimated figure of over $1,000,000,000 per year for labor and materials used in maintenance, one has a basis for judging Uncle Sam's annual bill for vehicle maintenance. It is an amazingly big figure. It has been estimated that America's truck owners can save over one-fourth of that $1,000,000,000 each year by strict observance of preventive maintenance measures. If you have any idea of how many vehicles the Army has (and I'm not going to tell you any military secrets) you can guess its preventive maintenance saving will amount to a pretty penny. "But wait" – you say – "you can't count dollars in war! Only the excellence and quantities of guns, ships, supplies, and personnel really count!"

Well, I *still* say that good maintenance, preventive maintenance, is splendid warfare!

Costs of war are figured in human lives and in materiel. Preventive maintenance of our vehicles can cut these costs and help to open the way for our victorious Armies. I'm *for it all the time*. I hope we can count on your help to make it work! I'm betting that we can!

Ordnance Automotive Experience in This War

continued from page 22

team is to improve and simplify our automotive vehicles of all types in the field, so that the maintenance problem is a constantly diminishing one. In other words, we as a team are applying to our Army automotive work exactly the same principles which have made the automobile and commercial truck so highly dependable. It readily can be appreciated that the Army problem is much more severe than is the commercial one because of the varied and rugged terrain over which we operate, and in many cases the totally inexperienced operators who man our vehicles. Our maintenance shops must be mobile and, of course, cannot equal those well established in the commercial world. And yet our progress toward reaching a high degree of dependability in operations is going forward in leaps and bounds. So much in proof of the fact that the Ordnance effort is an *industrial* effort of the entire United States.

When the weather is fair and the sky is blue and everything is sailing along, the life of Ordnance is very happy; but when combat is entered into, then, truly, our days merge into nights and our nights into the following day. Our anxieties are great and our burdens heavy to carry because we feel that we behind the lines are the support, in so far as weapons are concerned, of our friends of so many years in the combat services. We know that the very existence of the country may turn upon the result of our efforts as expressed in the development, the design, the production, the supply and the maintenance of the weapons of war being used by our troops on the battlefields of the world. The Army is a stern taskmaster. It places responsibility; it gives authority. If success is met with, the reward is within one's own self; if failure is met with, disgrace is the price. Responsibility is fixed, inescapable, and inexorable when one wears the uniform!

Ordnance is meeting its schedules – which are based upon the mobilization rate of our Army. Ordnance is meeting its schedules based upon the supply of weapons to our troops in combat zones. We are not out of balance to any greater extent than any large manufacturer in the piping times of peace. Our scheduling is done by men we have brought in from industry, and my authority for the last statement is from their mouths. If the automotive industry knows how to schedule, then also does Ordnance, as our scheduling is being done by men from your industry. Ordnance is doing its job as it has done it since the days of George Washington – some 167 years of success. The team "INDUSTRY-ORDNANCE" is not going to fail!

While in England recently, I was told that the Battle of Britain was won by the quality of a little airplane. It had just that split edge of superiority over the Germans which was required to knock them out of the sky. Finally, in that day when the enemy lost 185 planes, flesh and blood could not stand this, and the German High Command recognized that quality had won. The Battle of Britain was won through the vision of the engineers and production men who produced that superior airplane. So it was especially gratifying to me to be told by our High Command and many other officers using our equipment that never in their memory had our Army been so well equipped as at the present time; never had the equipment been of such superior quality.

I keenly feel my responsibility to the mothers and fathers of this country to provide for their boys the finest weapons that American engineering and production genius can produce. We old-timers in Ordnance are giving our experience and our skill in Ordnance leadership as we have never given, and so will continue until our armies are victorious. When people talk change in organization to you, make sure that they have the necessary know-how to provide your boys with an ever improving quality of weapons, so that they may continue to maintain the relative advantage which our Ordnance now gives them over our enemies. Let no one persuade you under this plea or that to sacrifice the advantage which we have given in our weapons to your boys in the fighting forces.

The great team of the American "ORDNANCE-INDUSTRY DEPARTMENT" will not be found wanting.

AMERICAN TECHNIQUES TOP AXIS RESULTS,

Democratic methods producing best armaments in world, Army men prove. SAE war effort praised. Maintenance needs stressed at every session. Attendance reaches new peaks.

WHILE American ground and air forces continued to rock the Axis with top-quality planes, tanks and guns, the military and civilian engineers who designed and built their equipment met in an SAE War Engineering Production Meeting to plot new ways to make American arms better than the best in the world. Site of the meeting was the Book-Cadillac Hotel, Detroit – and the time, Jan. 11 to 15. Attendance was higher than in any previous year.

Proof that America's free technicians – voluntarily cooperating – can out-design, out-research, and out-produce the Axis' state-controlled engineers was reflected in papers and discussions throughout the week. And the good news that American armed forces will be supplied with fighting equipment superior to that of our enemies regardless of materials shortages came from the very engineers who are directly responsible for designing performance into that equipment.

Sixteen military technicians, headed by Chief of Ordnance Major-Gen. Levin H. Campbell, Jr., talked technically with the SAE members as part of the formal program, while scores of other Army engineers participated in the 22 sessions,

Brig.-Gen. J. K. Christmas, assistant chief, Tank-Automotive Center, Ordnance Department. Although praising highly the war production achievements of the automotive industry, Gen. Christmas voiced the opinion that the contributions made by engineers from a design standpoint have been even greater

SAE WAR ENGINEERING MEETING HEARS

Chrysler President K. T. Keller, toastmaster at the dinner; SAE President Mac Short; Major-Gen. Levin H. Campbell, Jr., Chief of Ordnance; and SAE Past-President A. W. Herrington

all of which were devoted exclusively to war topics. Important officers who spoke included Brig.-Gen. S. G. Henry, Brig.-Gen. James Kirk, Brig.-Gen. J. K. Christmas, and Brig.-Gen. Walter B. Pyron.

The magnificent results of industry-military cooperation were attested by practically every officer who spoke, although a major part of each session was devoted to analyzing still existing needs for improvement and devising means for getting better equipment quicker.

Necessity for improved application of maintenance techniques and simplification of maintenance instructions was emphasized over and over again. In fact, the men about whom both military and civilian engineers seemed most concerned throughout the meeting were that well-known trio John Doe, Joe Doakes and Private Jones. These three fellows, everybody agreed, are the ones who must understand and apply maintenance procedures if trucks, tanks and planes are to be kept in action against the enemy – and a great deal of time was spent pointing out what engineers have left undone in simplification of designs, instructions and repair methods for their benefit. Although Doe, Doakes, and Jones were not registered as attendants at the sessions, their personal representatives held the platform throughout discussion after discussion. Outstanding representatives of the potent triumvirate undoubtedly were Brig.-Gen. Henry, commandant of the Armored Force School at Fort Knox, and Brig.-Gen. Kirk.

The effectiveness of democratic methods in procuring maximum technical results was brought out time and again during the week. "Procedures based upon sound, tried and proved economic precepts are being followed by Ordnance," Gen. Campbell key-noted. Then retiring SAE President A. W. Herrington, noting that American armament production has reached flood proportions in the short period of 12 months, stressed that "this is the American system of free enterprise at work" – while incoming President Mac Short, citing the vital war achievements of SAE committees, declared: "all of these are official proof of the ability of SAE engineers to get results by democratic methods – quickly and effectively."

In the various technical sessions, military vehicle, aircraft, parts, and fuel engineers – each discussing substitute mate-

rials possibilities in his own particular field – demonstrated clearly that many substitutions have been made and will be made without sacrificing durability or reducing the safety margin. The dramatic story of America's development of steel cartridge cases, told at an early session, bore further evidence of the effectiveness of the ingenuity and ability to cooperate of American automotive engineers.

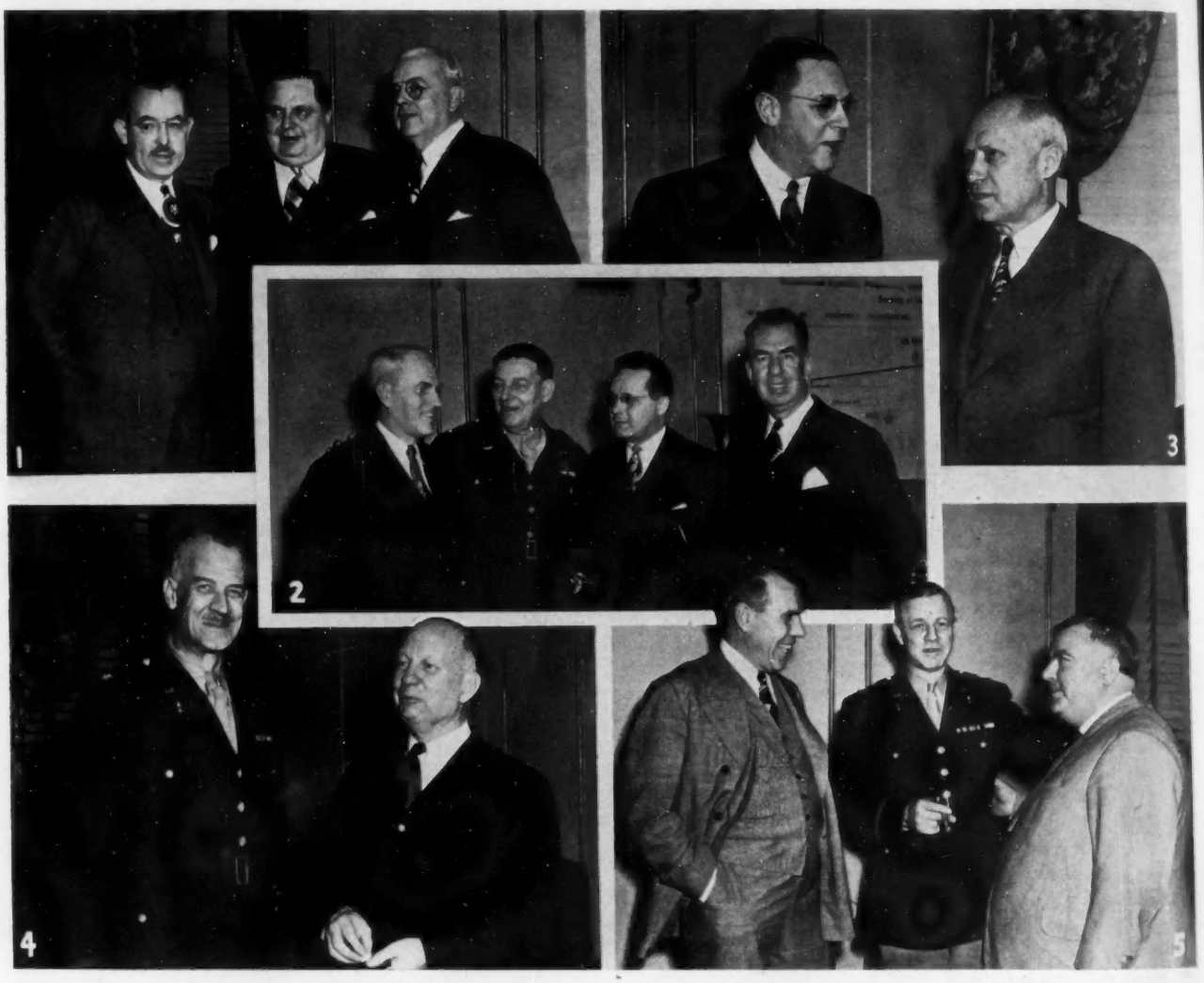
K. T. Keller, Dinner Toastmaster

Gen. Campbell – whose talk is printed in full beginning on p. 21 of this issue – was the principal speaker at the War Engineering Production Dinner, on Wednesday evening, which included a talk by retiring SAE President A. W. Herrington as well as President Mac Short's inaugural address. K. T. Keller, president, Chrysler Corp. and a member of Gen. Campbell's personal advisory staff, was toastmaster. Mr. Keller was introduced by Detroit Section Chairman E. W. Austin, following Mr. Austin's brief welcome to the assembled engineers.

Attendance at the dinner was larger than ever before, although it was confined to SAE members, applicants and members of the Armed Forces. The speakers' table included a distinguished group of industrialists as well as high-ranking Army and Navy officers.

So large was the attendance that dinner tables were set up in the Crystal Room as well as in the Grand Ballroom. Before the speaking program started, however, some tables were removed and seats provided for all in the Ballroom itself.

At the Dinner were Prominent Guests from All Branches of the Industry



1. E. W. Austin, Detroit Section chairman; George W. Mason, president, Nash-Kelvinator Corp.; and Carl Breer, executive engineer, Chrysler Corp.

2. Arthur Nutt, chairman, aeronautical division, SAE Standards Committee; Col. D. G. Lingle, Army member, working committee, Army-Navy Aeronautical Board; SAE President Mac Short, vice-president of engineering, Vega Aircraft Corp.; SAE Past-President A. W. Herrington, chairman, Marmon-Herrington Co., Inc.

3. SAE Past-President A. T. Colwell and O. E. Hunt, executive vice-president, General Motors Corp.

4. Col. E. S. Van Deusen, Ordnance Department, and Pyke Johnson, president, Automotive Safety Foundation

5. I. T. O'Brien, Chrysler Corp.; Major-Gen. T. J. Hayes, chief of industrial division, Office of Chief of Ordnance; George Hooper

W. C. MacFarlane, president, Minneapolis Moline Power Implement Co., and Brig.-Gen. A. B. Quinton, Jr., chief, Detroit Ordnance District, War Department

Albert Bradley, executive vice-president, General Motors Corp.; J. W. Frazer, president, Willys-Overland Motors, Inc.; and Major-Gen. Levin H. Campbell, Jr., Chief of Ordnance

Com. R. Velz, inspector of naval materiel, Navy Department

President Mac Short Stresses Unity in Stirring Inaugural

In an inaugural address characterized by listeners as a document of high statesmanship from an SAE standpoint, President Mac Short declared the chief aim of his administration as being "to accelerate the military performance, flexibility and production of automotive war equipment – and to encourage maximum interchange of technical knowledge between each branch of automotive engineering and every other branch, both civil and military."

Emphasizing the many points of similarity between the technical problems faced by aircraft engineers and those faced by automobile, truck and tractor engineers, President Short concluded that "the degree to which these major technical forces continue toward psychological integration – while maintaining full independence in engineering thinking and specialization – may well mark the degree to which the SAE is capable of accelerating its already important contributions to our war effort."

Stressing vigorously the growing understanding among various technical and geographical branches of the automotive industry, President Short said in part:

"It has been stated that this pleasant duty of serving as president for 1943 marks the first occasion when West meets East in directing the activities of SAE. There are broad spaces in engineering activities between East and West and many bases to be covered. However, I should like to bring the thought that these gaps can and will be more effectively closed through the cooperative efforts of the SAE than by any other single engineering group.

"The West is new – industrially speaking – and although many tall tales have come out of the West relative to war production and accomplishments, it is not all celluloid and seduction.

Capt. A. S. Wotherspoon, inspector of ordnance in charge U. S. Naval Ordnance Plant, Detroit, and B. E. Hutchinson, chairman, Finance Committee, Chrysler Corp.

I. B. Babcock, president, Yellow Truck & Coach Mfg. Co.; Brig.-Gen. A. B. Quinton, Jr., chief, Detroit Ordnance District, War Department; Col. Ray M. Hare; and George W. Romney, manager, Automotive Council for War Production

Brig.-Gen. S. G. Henry, Armored Force School, talked on training of technical specialists

Part of the group which entertained Gen. Henry at an informal dinner prior to his talk. Gen. Henry spoke under the auspices of the Junior-Student Activity of the Detroit Section. Those shown are: R. B. Sneed, Detroit Section junior-student vice-chairman; John A. C. Warner, SAE secretary and general manager; E. W. Austin, Detroit Section chairman; F. W. Marschner, Detroit Section treasurer; J. D. Caton; R. J. Cahill; and Earl Bartholomew

"The cordial relationship which exists between the West and the East – which may better be put in terms of the understanding between the aircraft and automobile engineers – is based largely upon the growing understanding and respect each group has acquired for the other as their daily work on common problems, developments and contracts has brought them face to face with increasing frequency. We have had, during the past year, more of an opportunity to observe each other's designing and production philosophy. In this vast welding of two major engineering forces in America's war team, the SAE has likewise been privileged to play a constructive part.

"The 80 aircraft engine, propeller, and accessory standards set up by SAE committees working for and with Government agencies; the 1,400,000 air-frame and aircraft engine materials specification sheets already distributed; the materials conservation and substitution reports from SAE committees which have made possible the saving of millions of pounds of critical materials in vital ordnance vehicles, aircraft, aircraft engines and weapons – all of these are official proof of the ability of SAE engineers to get results by democratic methods – quickly and effectively.

"Behind these official achievements lie thousands of cases in which war engineering progress has been stimulated by ideas exchanged informally with fellow technicians at meetings – and many contacts established through SAE channels have facilitated later exchange of information between men in different companies working on the same or related projects.

"The tax burden created by this war may easily affect the basic economic structure of our country. Our SAE military standardization work has been entirely financed by our Society and the private corporations for which its members work. The companies whose engineers have contributed their technical knowledge to the solution of these problems have given freely of their time.

"These funds, efficiently and economically administered by our experienced committees and staff, constitute a genuine and sizable contribution to the war effort.

"Turning again to aircraft and the matter of specific aid to the war effort, our SAE aircraft materials and processes committees offer to the Government and to industry the cooperation of a well-organized group of individuals who are thoroughly familiar with the details of the problems which they are handling and who are responsible representatives of the several individual companies forming the aircraft industry. This group is in a position to advise the Government and keep industry and the Government up to date on the requirements for materials and processes.

"The results of SAE war activities are being written by American airmen in American aircraft which – on the record – are downing enemy planes at the rate of about five to one; in the newest tanks whose crews are knocking off Axis tanks at 2000 yards; and in hundreds of other practical, effective weapons which automobile and aircraft engineers are providing – and daily improving – for our armed forces on battle fronts throughout the world."

Herrington Warns Against Isolationism

"Isolationism is not dead – it is only dormant," 1942 SAE President A. W. Herrington warned in his dinner address which marked the closing of his administration as president of the SAE. Mr. Herrington, who now takes his place on the SAE Council as Past-President, saluted the automotive industry for its major war accomplishments, but urged that our future national security demands "that we must ever be prepared to meet attack from any direction at any time."

Stressing that the technical advance of aviation will be so great in the next five years that never again in our history will any other nation be able to act as a buffer to hold off an aggressor while we get our production machinery rolling, Mr. Herrington said in part:

"We will live in constant danger of having our existing production facilities destroyed before we are aware that we have been attacked.

"This situation points strongly to the urgency of a foreign policy, after this war is over, which will require us to assume the full responsibility of our international obligations among the world family of nations. A return to isolationism is a positive step to national suicide.

"The military situation is so greatly improved over that which existed a year ago, that a wave of optimism with reference to the possible early end of this war is sweeping our country. Nothing could be more dangerous. It encourages our public to an uncooperative attitude toward essential rationing programs. It lays a groundwork for the isolationists in their intriguing propaganda of early return to normalcy.

"We are in the middle of a revolution. This is another of those continuous battles in which democracy, as a form of government, must engage to guarantee its continued existence and to progress to its goal of establishing a better form of government, bringing the greatest good to the most people.

"We cannot, we will not, return to the life we once knew. If that return is all we have to fight for, it is a hopeless struggle.

"The one optimism we can afford is that we will eventually be victorious. It is still a long, hard fight. The hardest fight is to win a successful and enduring peace.

"There will be great suffering and misery with the cessation of hostilities. The time will not be ripe for the immediate formation of corrective policies. There will be a time during which those who have sown the seeds of misery and destruction will reap the harvest of the inevitable functioning of the laws of retribution. We of the United States will have little stomach for this process, but there will be little we can do to prevent it. If we stoically accept it as a part of the process of the cleansing of this earth of the forces of evil which have come upon it – then we may look forward indeed to the coming of a better day.

"Our first duty, as citizens of this nation, is to make it our individual business to see that the people who will represent us at the Peace Conference shall be chosen from those who have accepted the duty call of our President and have risked their own lives to go out now and familiarize themselves with the true nature of these evil forces."

Gen. Henry Tells of Training John Doe-in-the-Army

"Do not feel conscience-stricken if your particular task does not happen eventually to be one in uniform," Brig.-Gen. Stephen G. Henry, commandant, Armored Force School, Fort Knox, Kentucky, told the Junior Student Session (held under Detroit Section auspices) on the opening night of the meeting. (*Gen. Henry's paper is scheduled for reproduction in full in the March issue of the SAE Journal.*)

"We of the Army have a job to do, but so does the civilian army which backs us up on the vital ever-important home front," Gen. Henry said, continuing: "The home, the school, the factory and the Army – they are our axis – greater than a thousand Berlin-Rome-Tokio Axes; and on their four spearheads we shall forge our way to victory – and the peace ahead."

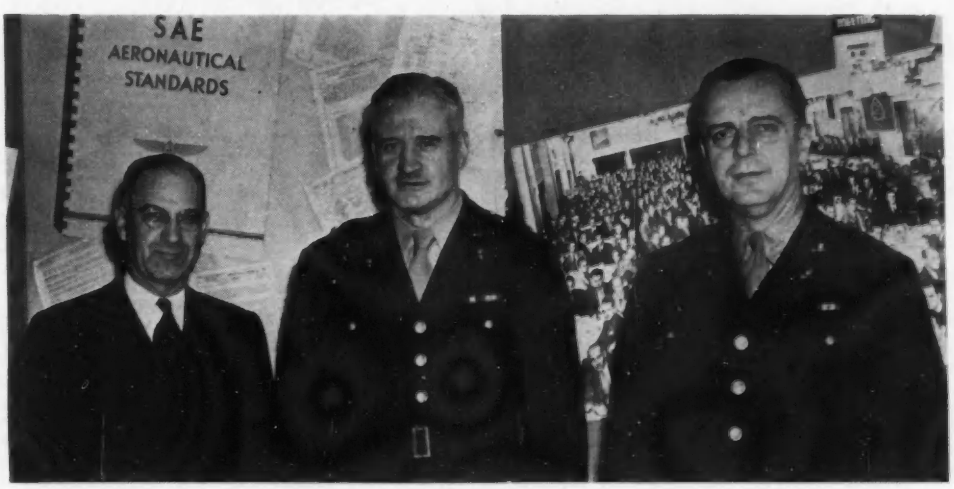
Gen. Henry described the genesis and operations of the Armored Force School, pointing out that the Armored Force – successor to the old tank force and the more recently motorized cavalry – was first formed in July, 1940. Then, from land where only blackberry patches and scrub-growth thrived, the Armored Force began to hew out one of the largest technical schools in the world. Now there are 250 officers and 2000 men *teaching* in the School. The students get a mechanic's course which, in civil life, would cost between $1500 and $2000.

"We teach a man," Gen. Henry said, "that a sick tank never takes care of itself," and added that throughout the school recently was posted this axiom: "Learn now so that you will live later." In this latter phrase, he said, is summed up the whole point of the training of a soldier for a specialized job.

It now takes about nine weeks to make a well-trained soldier mechanic, Gen. Henry said, as against about nine months some two years ago. Answering possible questions as to the quality of the nine-weeks product, Gen. Henry said: "I have been with tanks for more than 20 years and I honestly feel that the instruction has not suffered appreciably by this schedule tightening."

Cooperative Research Program Outlined

On Thursday evening, under the auspices of the National Meetings Committee, C. B. Veal, secretary, Cooperative Research Council, outlined the history of the cooperative SAE-American Petroleum Institute organization and described its current activities with special reference to its wide participation in the war effort. (*Mr. Veal's paper is printed in full in the Transactions Section of this issue.*)



James M. Crawford, chairman, SAE Military Motor Vehicles Meetings Committee under whose auspices several sessions were arranged; Brig.-Gen. James Kirk, Ordnance Department; and Col. T. L. Preble, Ordnance Department. Mr. Crawford's committee consisted of the Truck and Bus Activity Committee and the Passenger Car Activity Committee acting jointly with 1942 Vice-Presidents Fred B. Lautzenhiser and E. E. Wilson as vice-chairmen

Brig.-Gen. Walter B. Pyron, chairman, War Department Committee on Liquid Fuels and Lubricants, talked on Army fuels and lubricants requirements

Business Session

At the annual Business Session of the Society on Wednesday evening, the resolution proposing that the name of the Society be changed to "The Society of Automotive and Aeronautical Engineers" again was presented, and upon motion duly made and seconded was tabled for one year.

At this session, Past-President Arthur Nutt received Life Membership in the Society, the presentation being made by 1942 President A. W. Herrington. President Herrington also introduced Mac Short to the Society as its president for 1943 at this session. Responding briefly to his introduction, Mr. Short pledged his best efforts to fulfillment of the Society's aims in these trying times and bespoke the cooperation of all members in carrying out his task.

"SAE Works Technical Mine"—Bachman

In a report presented to the Business Session by Arthur Nutt in his absence, B. B. Bachman, chairman, SAE War Activity Council, reported briefly to members on the progress of the SAE war program and the policies upon which it is being conducted.

Likening the SAE membership to a great mine of technical knowledge, he said the SAE war effort is "to help the Government work this mine." Three factors, he pointed out, have made possible success for these efforts: first, recognition by Government agencies of SAE members as a vital war asset; second, whole-hearted support of SAE war work given by our members; and third, the backing which the corporations making up the aircraft and automotive industries have given these SAE activities. "Due to the generous manner in which industry has supported us through contributions to the SAE War Chest," Mr. Bachman emphasized, "we have been in a financial position to do the jobs which our Government has asked us to do."

Basic policies guiding the SAE war program were outlined by Mr. Bachman as: (1) projects are undertaken only at the specific request of the armed forces or other Government agency; (2) the Society functions in an advisory capacity on its war projects.

Amplifying this latter policy, Mr. Bachman concluded: "It has been felt that the SAE's job was to provide the best engineering answer it could on each problem presented. We have recognized, however, that the engineering answer may not be the complete answer. . . . Consequently, our work has ended with the submission of recommendations to the military and civilian war agencies. We have not brought any pressure to bear subsequently to urge the adoption of our recommendations. The fact that we have not functioned as a pressure group unquestionably has contributed to harmonious and effective operation, and this policy unquestionably has been a major factor in building for the SAE a reputation among Government agencies as a place where unbiased engineering assistance may be obtained without any of the strings which sometimes are attached to such assistance."

MILITARY VEHICLES SESSIONS

Chairmen

F. B. Lautzenhiser — **E. E. Wilson**

Three important sessions were arranged under the auspices of the war-born Military Motor Vehicles Meetings Committee under the chairmanship of James M. Crawford of Chevrolet. Comprising the members of the Passenger Car Activity Committee and the Truck and Bus Activity Committee and with 1942 Vice-Presidents E. E. Wilson and Fred B. Lautzenhiser as vice-chairmen, this committee set up two technical sessions completely under its own auspices; and in a third – that at which Brig.-Gen. James Kirk was the speaker – it participated jointly with the Transportation and Maintenance Activity Committee, of which 1942 vice-president Jean Y. Ray was chairman. (This session is reported on later pages under the heading of Transportation and Maintenance Sessions.)

To the Military Motor Vehicles Meetings Committee, too, goes credit for arrangements which brought Major-Gen. Levin H. Campbell, Jr., to Detroit as the chief speaker at the War Engineering Production Dinner.

Design and performance of military vehicles, and the problems of designing materials to build them, were covered in all the detail permitted by the exigencies of war by Army officers and civilian metallurgists whose work is being coordinated to bring remarkable achievements.

The problem in its simplest form, as one of the speakers said, was to make better, harder-hitting weapons with steel chemistries widely believed to be incapable of this achievement.

turn to page 57

PRESIDENT for 1943

MAC SHORT

The SAE's 38th president is Mac Short – World War I aviator, post-war barnstorming pilot, teacher of aeronautical engineering, designer of planes, founder and executive engineering officer of two aircraft-manufacturing corporations. His election bespeaks recognition of the services and abilities of an able, friendly, cooperative man of vision.

SAE member since 1925, SAE aircraft engineering vice-president in 1934 and again in 1941, general chairman of the SAE National Aircraft Production Meeting in 1939, chairman of SAE Southern California Section for 1940-41, and long active in many other SAE undertakings, President Short is fully familiar with SAE work and members.

As a graduate mechanical engineer and one of the early teachers of aeronautical engineering, he has a broad engineering background. As military pilot in the pioneering days of the Army Air Service, as airplane designer, as manufacturer, he has vision of the future of air transportation and of aeronautical engineering. As an organizer of corporations and of cooperative undertakings, and as engineering member of the West Coast Aircraft War Production Council, he has contributed to the growth and recognition of aviation in the United States and has aided in formulating means and methods whereby military aircraft production facilities could be expanded and coordinated to aid the war effort.

Friends say of Mac Short that he is not only one of the outstanding aeronautical engineers of the United States, but that his personal history practically is the story of American aviation. He has been interested in aviation and in aeronautical engineering since he enlisted in the U. S. Army Air Service during World War I at the age of 18. Shortly after the Armistice, he resigned his commission as flying lieutenant and entered Kansas State Agricultural College as a student in mechanical engineering. He earned his way through college by undertaking barnstorming flights during weekends and summer vacations, and was graduated in 1922 with the degree of Bachelor of Science.

After graduation he re-entered the Army service at McCook Field, Dayton, Ohio, as junior aeronautical engineer. From 1925 to 1927 he was an instructor in aeronautical engineering at Massachusetts Institute of Technology, where also he studied for his Master's degree.

Thereafter Mr. Short devoted his attention to the design and manufacturing phases of aviation. He was instrumental in founding the Stearman Aircraft Co., of Wichita, Kan., and for 10 years was its vice-president and chief engineer. In 1937 he organized and became president of Vega Aircraft Corp., of Burbank, Calif. Three years later, Mr. Short relinquished the administrative duties of the presidency to become vice-president for engineering so that he might devote his full time to engineering and to the further development of Vega-designed aircraft.

Since the start of World War II with its large demands upon producers of military aircraft, Mr. Short has been active not only in aeronautical engineering, but in developing cooperation among aircraft manufacturers to effect interchange of technical data and to expedite and increase the production of war planes.

A person who devotes 12 to 14 hours daily to aeronautical engineering obviously has little time for hobbies, yet President Short has two – designing and flying planes. Current developments demand that he indulge the hobby of designing to the point at which avocation becomes vocation. Current pressure of war work, which occupies every day and many nights, requires that, temporarily, he forego the enjoyment of flying. His friends say, however, that a cross-country flight is to President Short the enjoyable equivalent of golf and other sports, and that he looks forward to the happy day when once again he can resume flying.

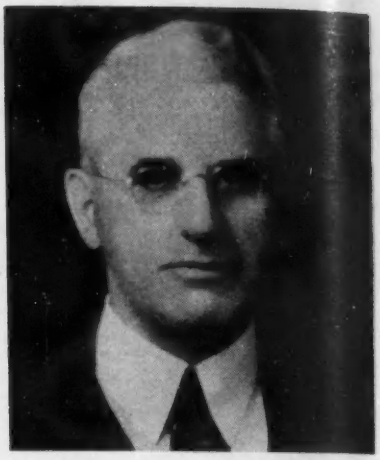
President Short was born in Kansas on Christmas Day, 1897. He was married on Sept. 6, 1924, to Mae B. Siefkin at Wichita. With Mrs. Short and the children – Sally, Dick, and Mary – he lives in his home at Glendale, Calif.

Mr. Short is a member of the Beta Theta Pi fraternity and of the Institute of Aeronautical Sciences.

★ SAE COUNCILORS

A. W. Herrington, Marmon-Herrington Co., Inc., president of SAE for 1942, takes his place on the 1943 Council as past president. David Beecroft, Bendix Products Division, Bendix Aviation Corp., will serve his eleventh consecutive year as treasurer. A. T. Colwell, 1941 president of SAE, continues on the Council as past president.

A. W. HERRINGTON



DAVID BEECROFT

A. T. COLWELL

C. G. A. ROSEN

Councilor C. G. A. Rosen (M'37) is director of research, Caterpillar Tractor Co. He served in machine shop, forge, foundry, and drafting room on oil-engine construction and repair after graduating from Cogswell Polytechnic College and the University of California with B.S. and M.E degrees. He was diesel engineer and chief engineer with the Dow Pump and Diesel Engine Co. from 1915 until 1922, when he engaged in practice as consulting and research engineer.

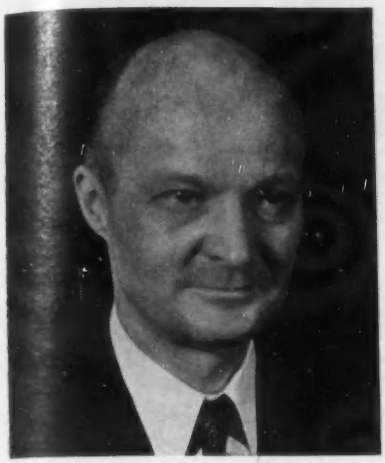
Mr. Rosen was SAE vice-president representing the Deisel-Engine Activity in 1940, and has been an active member of the Fuels and Lubricants Activity Committee. He is a member of the SAE War Engineering Board and a member of the War Advisory Committee, board of directors and chairman of the Cooperative Lubricants Research Committee of CRC.

★ ★

JAMES C. ZEDER

Councilor James C. Zeder (M '23), chief engineer of the Chrysler Corp., was graduated from the University of Michigan with a B.S. degree in

SAE COUNCILORS ★



W. S. JAMES

T. P. WRIGHT

J. VERNE SAVAGE

Continuing on the SAE Council are W. S. James, chief engineer, Studebaker Corp.; J. Verne Savage, superintendent, City of Portland Municipal Shops and Motor Vehicle Inspection Station; T. P. Wright, WPB Aircraft Production Board, and Director, Aircraft Resources Control Office. They are completing two-year terms to which they were elected last year.

1922. Following a brief period with the Timken Roller Bearing Co. as service and engineering representative, he went to work in the engineering laboratories of the Chrysler Corp. in 1923. In 1927 he became chief engineer of the Plymouth and DeSoto Divisions of Chrysler. In 1931 he was advanced to the position of assistant chief engineer, Chrysler Corp., in charge of laboratories, and in 1935 became chief engineer. For his outstanding work in the field of automotive engineering, Mr. Zeder received the degree of Doctor of Engineering from the University of Dayton in 1937.

Mr. Zeder is chairman of the SAE War Engineering Board, a member of the SAE War Activity Council, and vice-chairman of the Detroit Section for 1942-43. He was SAE vice-president representing the Passenger-Car Activity in 1940.

N. P. PETERSEN

Councilor N. P. Petersen (M '29), president and general manager of Canadian Acme Screw and Gear, Ltd., has been engaged in tool and design engineering as well as in developing its motor car parts manufacture, having previously managed the National Acme Co.'s Canadian plant.

He gained previous experience at the U. S. Naval Torpedo Station in Newport, R. I., the Taft-Peirce Co., and the Gillette Safety Razor Co. plants in Boston, London, and Montreal.

Active in the Canadian Section, he has served on the Papers and Program Committee, and was chairman of the Section in 1935-36.

★ ★

ROY COLE

Vice-President, Passenger-Car Activity

R. E. Cole (M '28) is vice-president in charge of engineering at The Studebaker Corp., South Bend, Ind. He has been an important figure in the field of automobile design for many years, having become chief of engineering of Dodge Bros. Corp. in 1928, following a wide experience with other car companies. Following a period of consulting work in the early 30's, Mr. Cole first joined the Studebaker organization as chief engineer of Rockne. When the Rockne personnel was merged with that of the parent organization, Mr. Cole was made executive engineer of Studebaker, assuming his present post in 1936.

Born at Columbia, Ohio, Mr. Cole attended Ohio State University and gained early experience in the engineering departments of Peerless, Garford, and Oldsmobile. Before joining Dodge Bros. Corp., Mr. Cole had served as chief engineer of Saxon Motor Car Co. and of Liberty Motor Car Co.

For three years, Mr. Cole has been a member of the SAE Passenger Car Activity Committee. He has been a member of the SAE War Engineering Board since its inception, and currently is sponsor for the W.E.B. Cold Operation Committee.

JOHN G. LEE

Vice-President, Aircraft Activity

John G. Lee (M '28), assistant director of United Aircraft Corp.'s Research Division since 1939, received his B. S. degree in mechanical engineering from Massachusetts Institute of Technology in 1921, and an M. S. degree in aeronautical engineering in 1922.

He was an instructor in aeronautics at MIT, and then joined the Curtiss Airplane & Motor Co. as draftsman and engineer. Later he became project engineer in the airplane division of the Ford Motor Co., and subsequently was project engineer for Fairchild Airplane & Engine Co. (and its successor American Airplane & Engine Co.). He first entered United Aircraft Corp. in 1932 as project engineer in the Chance Vought Division.

Mr. Lee has been an active member of the Aircraft Activity Committee and also of the Publication Committee. He was 1942 vice-chairman of the Sections Committee.

AUSTIN M. WOLF

Vice-President, Transportation & Maintenance Activity

Austin M. Wolf (M '11), is engineering consultant with the Development Branch of Ordnance. Mr. Wolf has been director of standards in the Division of Standards and Purchase of the State of New York for a number of years. He is well known to SAE members for articles analyzing new car trends which appeared in the *SAE Journal* from 1926 until 1938, as well as many other papers.

When Mr. Wolf joined SAE in 1911, he was draftsman for the Interboro Rapid Transit Co., New York. After serving as chief engineer for several companies, he embarked in 1928 on a career as consulting engineer, which he has continued.

Mr. Wolf has served as secretary and twice as chairman of the Metropolitan Section, and he has been on the National Transportation & Maintenance Activity Committee, Research Committee, Meetings Committee, Publication Committee, Truck Rating Committee, and National Membership Committee. He served on the SAE Council during 1940-41, and previously in 1935-36.

PRESIDENTS ★ ★

S. K. HOFFMAN

Vice-President, Aircraft-Engine Activity

S. K. Hoffman (M '29), chief engineer, Lycoming Division of The Aviation Corp., is a graduate of Pennsylvania State College.

Following his graduation, he joined the Reliance Electric & Engineering Co., where he worked on the application of electrical drives to special purpose machinery and on paper mill equipment in particular. He has been with such companies as Fairchild-Caminez Engine Co., Lycoming Mfg. Co., Allison Engineering Corp., and the General Motors Research Corp.

When Mr. Hoffman joined The Aviation Corp. in 1932, he started as project engineer and was made assistant chief engineer before assuming his present position.

GEORGE KRIEGER

Vice-President, Tractor & Farm Machinery Activity

George Krieger (M '30), is on leave of absence from the Ethyl Corp. for the duration. He is serving at present as deputy director of the Farm Machinery and Equipment Division, War Production Board, Washington.

Mr. Krieger once before, in 1935, was SAE vice-president for the Tractor Activity, and has been a member of this activity committee for many years. Currently he is chairman of the Tractor & Farm Machinery Conservation subcommittee of the SAE Tractor War Emergency Committee, and chairman of the Fuels and Lubricants Committee of the American Society of Agricultural Engineers. He is a life member of the American Agricultural Editors Association.

ARNOLD LENZ

Vice-President, Production Activity

Arnold Lenz (M '38), assistant manufacturing manager of the Chevrolet Division of General Motors, started as an apprentice at the age of 14 in the office of Sarasin, Staehelin and Co., Haagen, Germany. In 1906 he emigrated to this country, and spent his first two years at the New York State Normal School at Fredonia. In 1916 he joined the Buick Motor Co. in Flint as instructor in the foundry. He was successively with the Aluminum Casting Co. and the Grey Iron Foundry of the Saginaw Products Co.

When the Chevrolet Motor Co. took over the Grey Iron Foundry of the Saginaw Products Co. in 1927, Mr. Lenz went with Chevrolet as foundry manager. He was later made assistant manufacturing manager in charge of the Flint, Saginaw, and Bay City plants of Chevrolet. In 1941, Mr. Lenz was transferred to the Chevrolet central office in Detroit.

The University of Aachen, Germany, conferred upon him the honorary degree of Doctor of Engineering in 1934. In 1935 he received, through the American Foundrymen's Association, the Whiting Gold Medal.

WILLIAM M. HOLADAY

Vice-President, Fuels & Lubricants Activity

William M. Holaday (M '28), joined the laboratory staff of the Standard Oil Co. of Indiana shortly after he was graduated from Ohio State University in 1925 with a B.M.E. degree. In 1937 he became associated with the general laboratories of the Socony-Vacuum Oil Co., as research engineer.

From the beginning of his career in the petroleum industry, Mr. Holaday has been closely identified with development work in both fuels and lubricants. He was a member of the original Uniontown Road Test Group in 1932, and has participated in many of the subsequent field activities of the SAE. His memberships on CRC committees include both the CLR and CFR organizations working on motor, aviation, and diesel problems, and he is chairman of several of these committees.

As a member of the War Advisory Committee, Mr. Holaday is taking an active part in the conduct of work for the military services.

VICE PRESIDENTS

GROVER C. WILSON

Vice-President, Diesel-Engine Activity

Grover C. Wilson (M '36), recently joined the staff of the Universal Oil Products Co., as assistant director of the Automotive and Aircraft Department at Riverside, Ill.

Mr. Wilson taught internal-combustion engine courses at the University of Wisconsin, where he was director of the engine laboratory for 16 years. From 1929 to 1938 he was engaged in research work on high-speed diesel engines, during which period he collaborated with Prof. R. A. Rose in the development of the Rose Indicator, which was among the first indicators to apply the photo-electric tube and cathode-ray oscillograph to combustion studies. He has conducted several surveys among the diesel engine manufacturers for the Refiners' Committee of the American Petroleum Institute.

He was 1941-42 chairman of the Milwaukee Section of SAE, and program chairman for the Diesel Activity of SAE for two years. During World War I Mr. Wilson was a lieutenant in the Anti-Aircraft Service in France.

GEORGE J. MONFORT

Vice-President, Passenger-Car-Body Activity

George J. Monfort (M '26), has been an engineer with the Chrysler Corp. since 1924. At present he is engaged in material specification analysis.

He was graduated from the University of Michigan with a B.S.M.E. degree in 1913. From 1915 to 1918 he worked in the Body Division of the Cadillac Motor Car Co. and the French Mission at Packard. He has been a member of the Passenger-Car-Body Activity Committee for several years.

E. W. ALLEN

Vice-President, Truck & Bus Activity

E. W. Allen (M '37), is coach engineer at the General Motors Truck and Coach Division, Yellow Truck and Coach Mfg. Co., Pontiac, Mich. Excused from graduation at the University of Colorado in 1918, he resigned from the Engineers Reserve Corps to serve as an instructor of motor mechanics at Camp Mabry, Tex. He received his B.S. degree in 1918, and his M.E. degree in 1931. His military duties ended in 1919 as candidate in training school at Aberdeen Proving Ground, Md.

Back in civilian life, he then spent four years in tool and parts design for Moline Plow Co., Root and VanDerVoort, International Harvester and Yellow Sleeve Valve Engine Works, a former subsidiary of the company with which he now is connected and with which he is serving his 20th year. In 1926 he became chief draftsman of the engine division at Pontiac. He later served as head of that section, and for the last six years has held his present position. Since 1940 his duties have largely shifted from the commercial engine and coach lines to military vehicles.

Mr. Allen has been active on the Truck & Bus Activity Committee and subcommittees.

REPORTS OF COMMITTEES

Society of Automotive Engineers
29 W. 39th St., New York, N. Y.

January, 1943

Emphasis Put on Engineering Aid to War Program at 11 SAE Meetings Held Throughout United States in 1942

by Ralph R. Teetor

Chairman, SAE Meetings Committee

THE meetings program of SAE during the administrative year 1942 comprised 11 meetings, including several special sectional and regional meetings planned to take the place of the regular Summer Meeting, which was ruled out by transportation priorities.

The Meetings Committee had charge of the general arrangements for the Annual Meeting. The technical sessions at these meetings were handled, for the most part, by the respective Professional Activity Committees. These committees also arranged for technical meetings other than the Annual Meeting.

Promote War Effort

Emphasis at all meetings was placed upon the vital importance of engineers and engineering to the war effort and the place of SAE in the war effort. Addresses by prominent military officials were part of almost every meeting of the year.

Display War Equipment

Several meetings included displays of especial interest to engineers engaged in war activities. One session at the Aeronautic Meeting featured the exhibition and analysis of a Junkers 211-B engine taken from a captured German twin-engine bomber. At other meetings, a Japanese aircraft engine, the Mitsubishi Kinsei, was exhibited and analyzed. At the SAE-ESD Aircraft War Production Meeting in June, the Ford Motor Co. presented an exhibit of Ford activities in connection with the war effort. The West Coast T&M Meeting featured a display of Army motorized equipment. Other mechanized war equipment, its component parts, and military applications of rubber made up one of the most interesting exhibits ever displayed at an SAE meeting: this exhibit was presented at the Cleveland Section's Regional Meeting in August. As in the past, the National Aircraft Production and Annual Meetings included extensive engineering displays of new products, exhibited by numerous companies.

The T&M Meeting in New York in October was designated as the 1942 Semi-Annual Meeting of the Society. A business session was held on Oct. 7.

Sections Cooperate

The Meetings Committee takes this opportunity to express its appreciation to the Sections which assisted so capably in connection with the meetings held in their respective territories, namely, Chicago, Cleveland, Detroit, Metropolitan, Milwaukee, Northern California, Northwest, Oregon, Southern California, and the Southwest Group.

Meeting	Place	Date	No. of Sessions	No. of Papers	Attendance
Aeronautic	New York, N. Y.	Mar. 12-13	6	14	519
SAE-ESD Aircraft War Production	Detroit, Mich.	June 8	3	4	4000
ASME-SAE Oil & Gas Power Conference	Peoria, Ill.	June 17-19	5	11	500
West Coast Regional Transportation & Maintenance	Los Angeles, Calif.	Aug. 20-22	7	8	320
Cleveland Regional	Cleveland, O.	Aug. 21	1	5	1046
Aircraft Production	Los Angeles, Calif.	Oct. 1-3	8	15	1444
War Transportation & Maintenance	New York, N. Y.	Oct. 7-8	4	4	210
Fuels & Lubricants	Tulsa, Okla.	Oct. 22-23	6	9	128
Milwaukee Tractor	Milwaukee, Wis.	Nov. 6	3	4	325
Air Cargo Engineering	Chicago, Ill.	Dec. 8-9	5	13	510
Annual Meeting	Detroit, Mich.	Jan. 11-15, 1943	22	46	(1959)*

*1942 Annual Meeting attendance.

SAE Sections, Growing in Numbers and Activities, Promote Exchange of War Engineering Information

by George A. Delaney,

Chairman, SAE Sections Committee

DURING the first full year of war, SAE Sections have done more than their part in bringing engineers together to discuss important problems and to further the interchange of technical information so important at this time.

Faced with unsettled conditions, forestalling in many instances the possibility of scheduling speakers far in advance, Section Governing Boards have arranged outstanding sessions which have attracted an increasing number of members to meetings. Attendance records indicate that more than 32,000 members and guests attended SAE Section and Group meetings in 1942, an increase of approximately 20% over 1941.

The general breakdown of topics at these meetings as shown on the accompanying chart reflects the success of Section Governing Boards in planning programs in keeping with the times.

New Section Organized

Organization of the Texas Section in 1942 brings the total number of SAE Sections to 23. The Texas Section was authorized by the SAE Council in August after successfully functioning as an SAE Group for several months. The new Section already has done much to further SAE objectives in Texas and has greatly increased membership in that area.

Two informal SAE organizations, the SAE Muskegon Club and the SAE Peoria Group, were formed in 1942. Five such organizations now carry on SAE activities in centers not served by SAE Sections. Those previously organized include the SAE Club of Colorado, the SAE Southwest Group, and the SAE Mohawk-Hudson Group.

Increased Committee Activity

Activities of Section and Group Committees contributed greatly to the success of the local organizations. Despite the fact that the majority of committee members were directly engaged in war industries and had fewer hours for outside activities, these members cooperated fully with their officers in making 1942 one of the most successful Section years.

Cooperate in National Meetings

The Detroit, Metropolitan, and Southern California Sections and the Southwest Group

were hosts to SAE National Meetings and actively cooperated in making these meetings outstanding.

Special mention should be made of the West Coast Transportation and Maintenance Meeting sponsored jointly by the four SAE Pacific Coast Sections, of the special War Production meetings and exhibits held during the summer by the Detroit and Cleveland Sections, of the Tractor Meeting sponsored by the Milwaukee Section, and of the Air-Cargo Engineering Meeting held under the auspices of the Chicago Section.

Too much credit cannot be given to the Section Governing Boards for the effort they have expended in advancing their Sections in these critical times. We appreciate their wholehearted cooperation.

SAE SECTION MEETINGS
1942

Subjects	
Aeronautics (Military & Civil)	49
War and Defense	26
Transportation and Maintenance	25
Materials	23
Fuels and Lubricants	18
Military Motor Vehicles	11
General	11
Production	10
Parts and Accessories	9
Social	9
Passenger Car	6
Tractor	6
Diesel Engine	4
Student	4
Total number of meetings held	211

SAE Publications, Gearing Editorial Policies to Wartime Program, Are Liaison Between Engineers and Military

by Earl H. Smith, Chairman, SAE Publication Committee

EDITORIAL policies of the Publications Department were put on a war service basis in 1942 and were geared to the war program of SAE. Governed by the principle that the engineering aspects of mechanized warfare and the engineering phases of the nation's war effort were subjects of primary importance, and paced by the progress of the war itself, the *SAE Journal* essayed to:

1. Publish timely, pertinent, technical news and reports on the engineering aspects of war developments;
2. Publish technical papers dealing with basic automotive engineering studies as well as those related directly to war problems – in the belief that both types of papers contribute specifically to the war effort;
3. Provide a medium whereby military authorities might effectively disseminate vital technical data for the guidance and benefit of engineers in the war-production industries;
4. Report and interpret developments affecting the impact of war upon industry;
5. Maintain technical and personal news contacts between SAE and members whose occupations and interests are changed by war;
6. Inspire patriotic service by revealing war engineering needs.

During the disturbed and confusing period immediately subsequent to Pearl Harbor, editorial policy recognized the necessity for publishing reliable news reports and as much technical war information as could be obtained in such a way as to create some semblance of orderly progress from the chaotic miscellany of developments. The endeavor was to present understandably the progress of Governmental organization for war in its relation to current work being done by SAE members.

At a time when dependable information was limited, the *SAE Journal* published reasonably complete information on the personnel and set-up of war bureaus and the scope of their authorities, on appointments of key personnel, on designs and materials needed for war production, on materials rationing and conservation, on development of substitute materials, and other data directly affecting war production.

This information grew from careful consideration of newly-established *SAE Journal* staff activities in Washington and of data and experience developed throughout the year by SAE technical committees working in military and Government assignments.

Technology of War

As the production of war equipment got under way, the *SAE Journal* devoted increasing space to important technical and semi-technical articles prepared by military engineering authorities and officers for the understanding and guidance of SAE members. This material constituted a substantial proportion of the more than 100 pages, presenting 18 technical articles and eight articles of general interest.

Military authorities contributed specially prepared and exclusive engineering treatises revealing engineering aspects of the design, production, and field use of military motor vehicles and aircraft. Through the pages of the *SAE Journal*, ranking officers outlined the engineering requirements of superior war equipment and reported service experience as an aid to the preparation of future designs. These articles served helpfully to coordinate the military, engineering, and industrial points of view, and were direct contributions to the tremendous task of supplying the American Armed Forces with superior equipment.

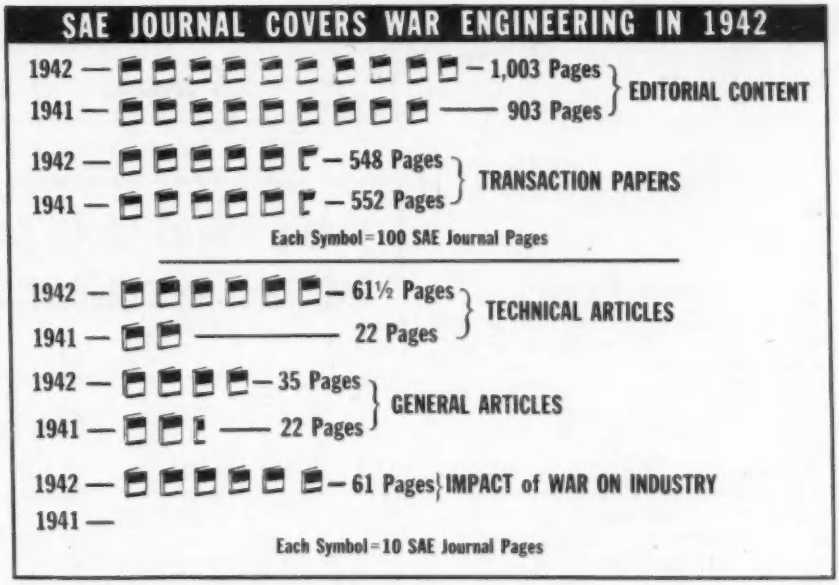
Promote Military Training

Addresses delivered by officers of the U. S. Army and Navy before local, sectional, and national meetings of SAE were published at length as a further aid to the process and the progress of military engineering education. Special feature articles on the design and construction details of captured enemy equipment were published as rapidly as available and to the fullest possible extent, so that American engineers responsible for supplying the American forces and their allies with war equipment might have full knowledge of conditions to be met.

War and Industry

More than 60 full pages were devoted to continuing the comprehensive news and technical reports of the rapidly-changing Washington scene. The "Impact of War upon Industry" section of the *SAE Journal* gave engineers and industrialists advance, and interpreted, information on official developments directly affecting war-engineering and war-production activities. Much of this information was published exclusively in the *SAE Journal*, and a considerable proportion received initial publication in the *SAE Journal*.

From the variety of technical papers presented at Society meetings, the *SAE Journal*


SAE JOURNAL COVERS WAR ENGINEERING IN 1942
1942 — 1,003 Pages
1941 — 903 Pages
EDITORIAL CONTENT
1942 — 548 Pages
1941 — 552 Pages
TRANSACTION PAPERS
Each Symbol = 100 SAE Journal Pages
1942 — 61½ Pages
1941 — 22 Pages
TECHNICAL ARTICLES
1942 — 35 Pages
1941 — 22 Pages
GENERAL ARTICLES
1942 — 61 Pages
1941 —
IMPACT of WAR ON INDUSTRY
Each Symbol = 10 SAE Journal Pages

selected for timely publication those which contributed to the war effort. These papers were published in full, with illustrations, and frequently were accompanied by enlightening discussions.

The published reports of all meetings of SAE, sections, and local groups were expanded so as further to disseminate technical information on the war and better to serve the Society's busy members. Comprehensive summaries of papers and proceedings of the meetings, with progress reports of the many war-service projects of SAE, contributed to the more than 175 pages of news of SAE published during 1942. Meeting reports became increasingly important, and accordingly were given more space, as military authorities grasped these timely opportunities to contribute to war engineering information.

Personnel Changes

Widespread changes wrought by war affected all members of SAE. Many entered military service, others entered war work. Many members were appointed to new positions. There was an extensive removal of engineers from industrial to war-production centers. To maintain contacts between SAE and its members, and between the members themselves, the *SAE Journal* increased to 45 pages the space devoted to personal items.

Despite the greater space allotted to war information, 55 complete papers and parts of others were published in the *SAE Journal*. This material occupied 548 pages, the equivalent of a large modern volume of engineering information with emphasis upon war requirements.

A statistical review of the contents of the *SAE Journal* for 1942 reveals that the 12 issues contained a total of 1003 pages of text, as against 903 in 1941, and 763 pages of revenue advertising as compared with 629 the prior year. The Transactions Section comprised 548 pages in 1942 as against 552 in 1941, but the number of pages devoted to special technical articles was increased to 61 from 22. Articles of general interest, relating chiefly to war developments, occupied 35 pages in 1942 as compared with eight in 1941. In both years technical treatises made up more than 60 per cent of editorial content.

Public Relations Activity

Special efforts were made to publicize the activities of SAE and technical and other information from the *SAE Journal* through timely distribution of news and other releases to trade journals and newspapers. Advance information on national and sectional meetings was widely distributed, with resulting broad publication in newspapers throughout the country.

Work of Section Committees, War Program, Lift SAE Membership to All-Time Record Total, 8253

by R. F. Steeneck, Chairman, SAE Membership Committee

ALL records were broken during 1942 as SAE membership reached 8253. New peaks were recorded in applications received, new members qualified, and Student Enrollment.

Section Membership Committees largely were responsible for this growth, working in close cooperation with the General Membership Committee. Recognition of the Society's important participation in the war effort is likewise reflected in this expansion.

Comparison of 1941 and 1942 membership figures is shown below. All 1942 figures are estimated.

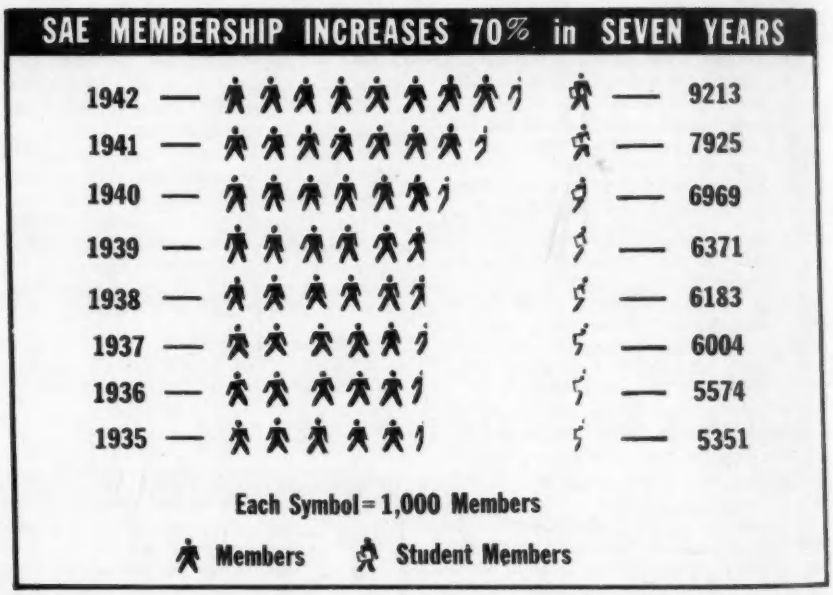
	As of December 31	
Type of Membership	1941	1942
Member	3645	3990
Associate	1858	2050
Junior	966	1470
Foreign	436	385
Service	154	200
Departmental	6	6
Affiliate	85	88
Affiliate Repr. (additional)	65	64
	7215*	8253*
Student Enrollment	710	960
	7925*	9213*

*Included in the above totals are Reserve Members who numbered 281 as of December 31, 1941, and 370 as of the same date 1942.

Applications Received

During the past 12 months, 1741 applications for membership and reinstatement in the Society were received. This topped the 1941 record of 1290 by 35%. New members qualifying for membership in 1942 totaled 1300 as compared with 1035 last year.

The Membership Committee is extremely thankful for the cooperation it has received from the Section Membership Committees and the membership in general in bringing SAE to the attention of prospective members.



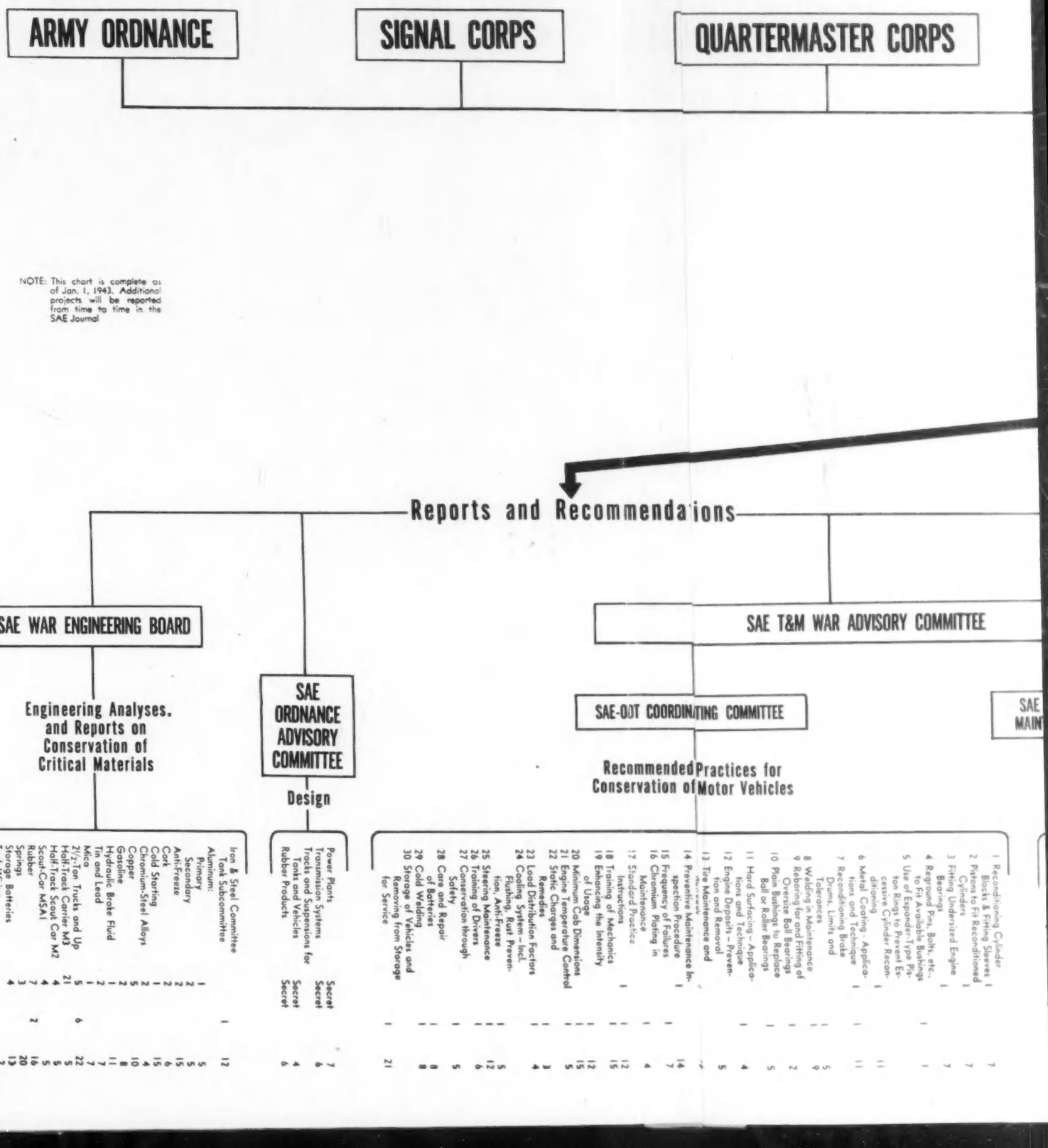
Undergraduates of 43 Colleges Now Are Enrolled in SAE; Three New Student Branches Organized in 1942

by W. K. Creson, Chairman, SAE Student Committee

MOST active student year in SAE history, 1942 saw three new Student Branches receive their charters from the Council and most other Student Branches conducting excellent programs. SAE now has 13 Student Branches, and SAE Enrolled Students are studying at 30 other schools and universities.

Student enrollment reached a new high of 1127 at the close of SAE's fiscal year, Sept. 30. Graduation and induction into

Government Agencies


ARMY ORDNANCE
SIGNAL CORPS
QUARTERMASTER CORPS
NOTE: This chart is complete as of Jan. 1, 1943. Additional projects will be reported from time to time in the SAE Journal
Reports and Recommendations
SAE WAR ENGINEERING BOARD
Engineering Analyses, and Reports on Conservation of Critical Materials
SAE ORDNANCE ADVISORY COMMITTEE
Design
SAE T&M WAR ADVISORY COMMITTEE
SAE-ODT COORDINATING COMMITTEE
Recommended Practices for Conservation of Motor Vehicles
SAE MAIN
Iron & Steel Committee
Tank Subcommittee
Aluminum:
Primary
Secondary
Anti-Freeze
Cork
Cold Starting
Chromium-Steel Alloys
Copper
Gasoline
Hydraulic Brake Fluid
Tin and Lead
Mica
2½-Ton Trucks and Up
Half-Track Carrier M3
Half-Track Scout Car M2
Scout-Car M5A1
Rubber
Springs
Storage Batteries
Tank Wiring
Inhibitors
Extreme Temperature Electrical Equipment
Power Plants
Transmission Systems
Tracks and Suspensions for Tanks and Vehicles
Rubber Products
Secret
Secret
Secret
1 Reconditioning Cylinder Blocks & Fitting Sleeves
2 Pistons to Fit Reconditioned Cylinders
3 Fitting Undersized Engine Bearings
4 Reground Pins, Bolts, etc., to Fit Available Bushings
5 Use of Expander-Type Piston Rings to Prevent Excessive Cylinder Reconditioning
6 Metal Coating - Applications and Technique
7 Reconditioning Brake Drums, Limits and Tolerances
8 Welding in Maintenance
9 Reboring for and Fitting of Oversize Ball Bearings
10 Plain Bushings to Replace Ball or Roller Bearings
11 Hard Surfacing - Applications and Technique
12 Engine Deposits - Prevention and Removal
13 Tire Maintenance and
14 Preventive Maintenance Inspection Procedure
15 Frequency of Failures
16 Chromium Plating in Maintenance
17 Standard Practice Instructions
18 Training of Mechanics
19 Enhancing the Intensity of Usage
20 Minimum Cab Dimensions
21 Engine Temperature Control
22 Static Charges and Remedies
23 Load Distribution Factors
24 Cooling System - Incl. Flushing, Rust Prevention, Anti-Freeze
25 Steering Maintenance
26 Training of Drivers
27 Conservation through Safety
28 Care and Repair of Batteries
29 Cold Welding
30 Storage of Vehicles and Removing from Storage for Service

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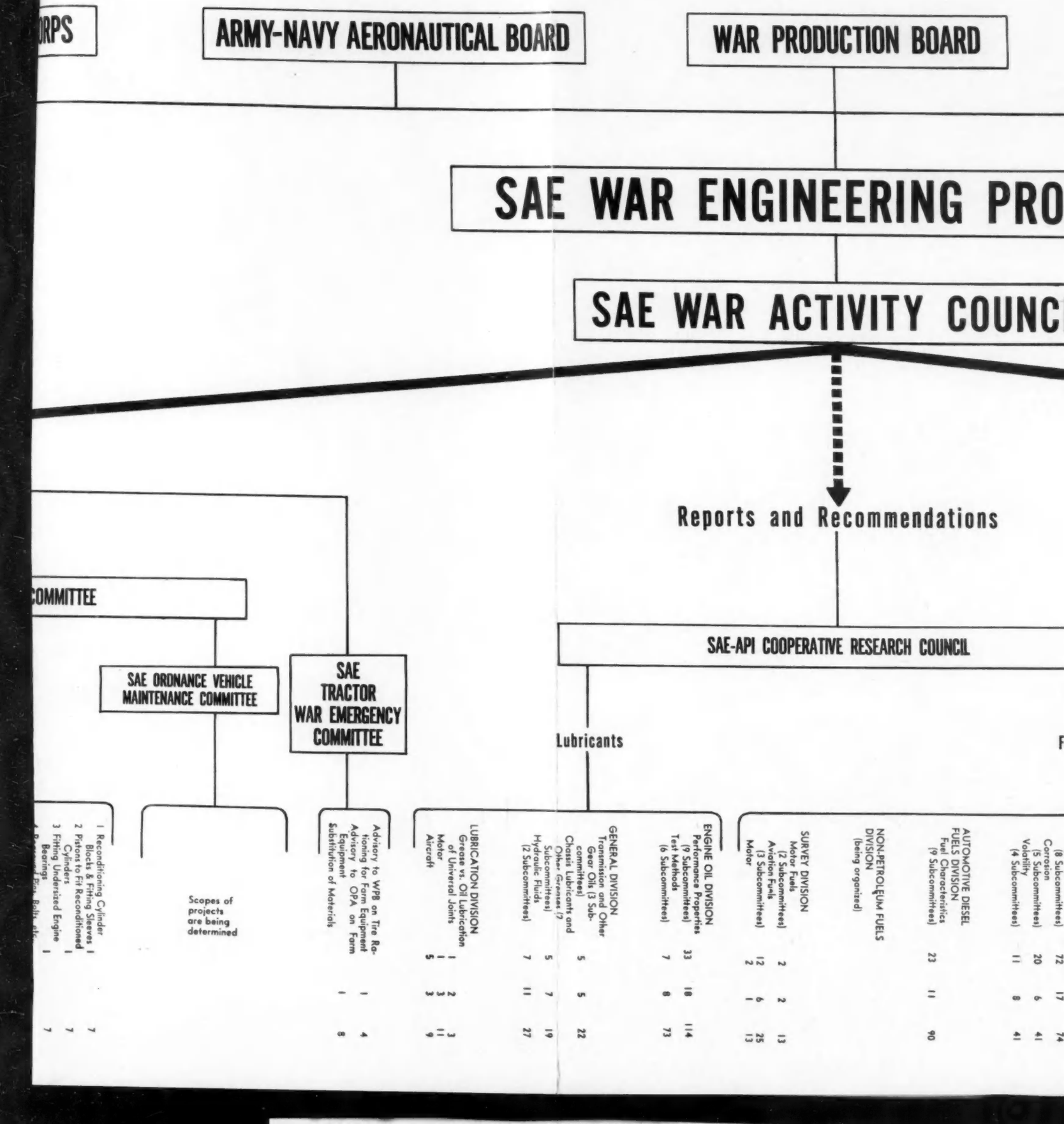
Society of Automotive E


ORPS
ARMY-NAVY AERONAUTICAL BOARD
WAR PRODUCTION BOARD
SAE WAR ENGINEERING PRO
SAE WAR ACTIVITY COUNC
Reports and Recommendations
COMMITTEE
SAE ORDNANCE VEHICLE MAINTENANCE COMMITTEE
SAE TRACTOR WAR EMERGENCY COMMITTEE
SAE-API COOPERATIVE RESEARCH COUNCIL
Lubricants
F
1 Reconditioning Cylinder Blocks & Fitting Sleeves 1
2 Pistons to Fit Reconditioned Cylinders 1
3 Fitting Undersized Engine Bearings 1
Scopes of projects are being determined
Advisory to WPB on Tire Rationing for Farm Equipment 1
Advisory to OPA on Farm Equipment Substitution of Materials 1
LUBRICATION DIVISION
Grease vs. Oil Lubrication of Universal Joints 1 2 3
Motor 1 3 11
Aircraft 5 3 9
Hydraulic Fluids (2 Subcommittees) 7 11 27
Subcommittees) 5 7 19
GENERAL DIVISION
Transmission and Other Gear Oils (3 Subcommittees) 5 5 22
Chassis Lubricants and Other Greases (2 Subcommittees) 5 7 19
ENGINE OIL DIVISION
Performance Properties (9 Subcommittees) 33 10 114
Test Methods (6 Subcommittees) 7 8 73
SURVEY DIVISION
Motor Fuels (2 Subcommittees) 2 2 13
Aviation Fuels (3 Subcommittees) 12 6 25
Motor 2 1 13
NON-PETROLEUM FUELS DIVISION (being organized) 90
AUTOMOTIVE DIESEL FUELS DIVISION
Fuel Characteristics (9 Subcommittees) 23 11
Volatility (4 Subcommittees) 11 8 41
(8 Subcommittees) 72 17 74
Corrosion (5 Subcommittees) 20 6 41
7
7
7
7

SITY ENGINEERING PROJECTS of the Engineers

OFFICE OF DEFENSE TRANSPORTATION

OTHER CIVILIAN GOVERNMENT AGENCIES

OTHE

PROJECTS

UNCIL

Standardization

SAE AERONAUTICS DIVISION

SAE GENERAL STANDAR

SAE QUARTERMASTER ADVISORY COMMITTEE

Standardization

SAE ELECTRICAL ADVISORY COMMITTEE

Standardization

Fuels

Aircraft Engine Standards

Aircraft Accessory Standards

Aircraft Propeller Standards

Aircraft Materials Specifications

Materia Specifica and Stand

MOTOR FUELS DIVISION
(6 Subcommittees) 24 71 66
Full-Scale Engine Detonation (3 Subcommittees) 5 8 27
Motor Fuel Volatility (3 Subcommittees) 5 10 14
General (3 Subcommittees) 2 7 27

AVIATION FUELS DIVISION
Full-Scale Detonation (6 Subcommittees) 13 19 56
Laboratory Detonation (7 Subcommittees) 6 10 123
Vapor Lock (8 Subcommittees) 72 17 74
Corrosion (5 Subcommittees) 20 6 41
Volatility (4 Subcommittees) 11 8 41

Vehicle Bodies Secret
Chassis Secret
Electrical Equipment Secret
Engines Secret
Transmissions and Axles Secret

Generators and Starters Secret
Instruments Secret
Controls Secret
Low Tension Cables Secret
Lighting Equipment Secret
Connectors Secret

E-1 Carburetor Installations 18 9 6
E-2 Engine Accessory Drives 12 4 5
E-3 Magnetos 4 1 4
E-4 Sparkplugs, Shielding, etc. 5 3 5
E-5 Standard Parts 11 20 5
E-6 Screw Threads 2 2 4
E-7 Involute Splines 1 1 6
E-8 Drafting Room Practice 1 1 6
E-9 Preservation of Engines 14 12 6
E-10 Surface Finishes 1 1 5
E-11 Engine Performance Data 7 1 5
E-12 Design Data and Drawings 1 3 5
E-13 Engine Vibration 2 5
E-14 Automatic Engine Power Controls 1 3
E-15 Small Propeller Parts 5
E-16 Cold Starting 5

A-1 Aircraft Pumps 5 5 6
A-2 Electrical Equipment 5 7 6
A-3 Valves and Fittings 8 5
A-4 Aircraft Instruments 8 4
A-5 Landing Gear Units 2 5
A-6 Hydraulic Equipment 18 15 7
A-7 Heat Transfer Units 2 1 8
A-8 Radio Equipment 4
A-9 Air-Conditioning Equipment 7 5
A-10 De-Icer Equipment 6 45 7
A-11 Pyrotechnics 1 4

P-1 Cuff Clearance 6 4
P-2 Clearance for Governors 1 2 3
P-3 Test Club Standards 2 2
P-4 De-Icer Connections 1 4
P-5 Dual Rotation Shafts Secret 4
P-6 Revision of Standards 1 8 4
P-7 Retaining Nuts 4 4
P-8 Control of Two-Speed Gears Secret 3 3
P-9 Static Balance Test 3 3

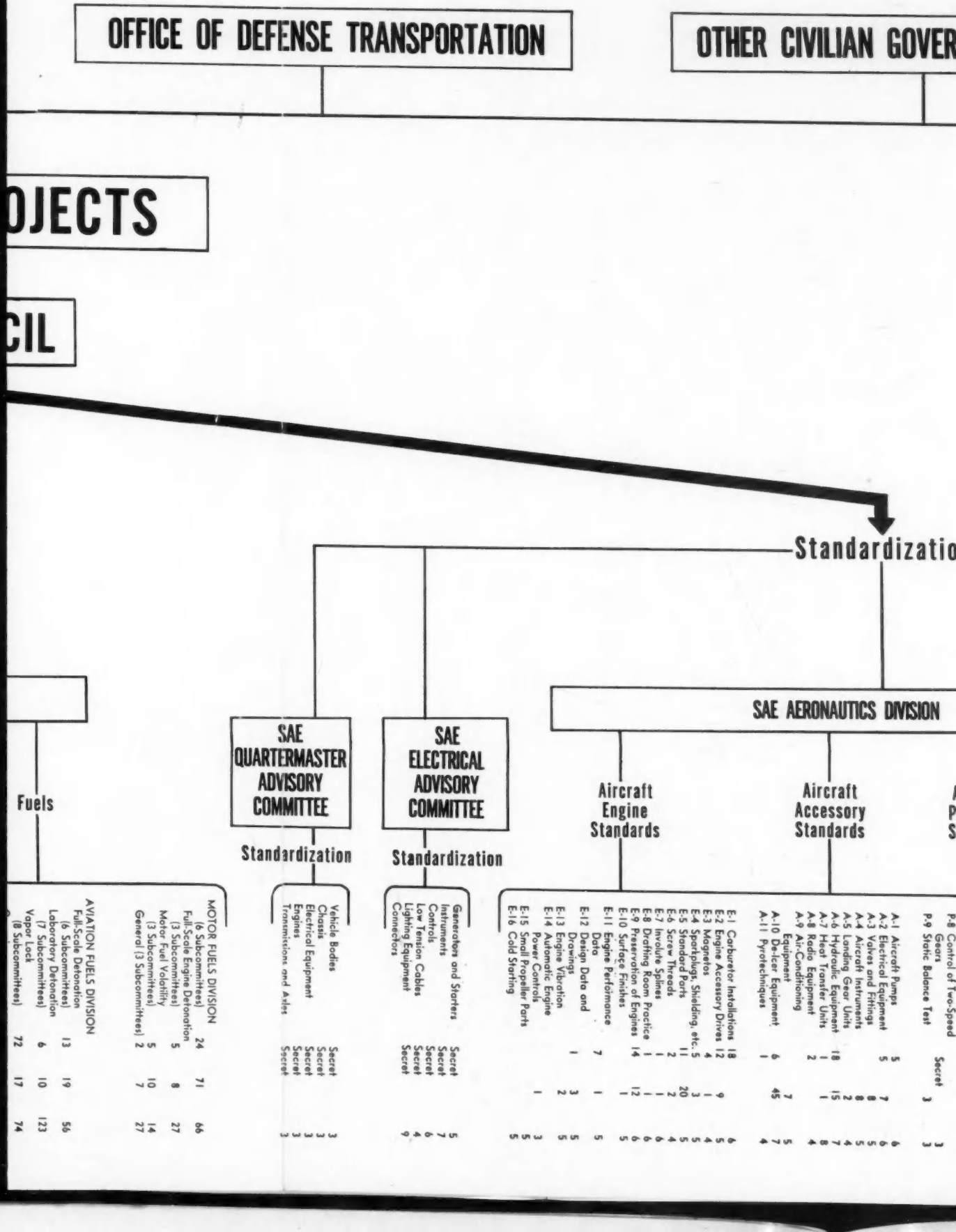
Aircraft ENGINE Materials and Processes 8 17 17
Aircraft AIRFRAMES Materials and Processes 34 43 18
Aircraft ACCESSORY Materials and Processes 206 110 11

Magnesium - Wrought 1 1
Copper Base Alloys 16

JOINT SAE-ASTM TECHNICAL COMMITTEE A - RUBBER 1 1 10
1. Engine Mounts 1 10
2. Rubber Bumpers 1 10
3. Brake Hose 10
4. Natural Rubber 1 10
5. Synthetic Rubber 1 10
6. Automotive V Belts 1 10
7. Hardness Testing 1 10
8. Cooling System Hose 1 10
Aeronautical Screw Threads 1 11

TY ENGINEERING PROJEC

Engineers


OFFICE OF DEFENSE TRANSPORTATION
OTHER CIVILIAN GOVER
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Standardizatio
SAE AERONAUTICS DIVISION
Aircraft Engine Standards
Aircraft Accessory Standards
SAE ELECTRICAL ADVISORY COMMITTEE
Standardization
SAE QUARTERMASTER ADVISORY COMMITTEE
Standardization
Fuels
P-8 Control of Two-Speed Gears Secret 3
P-9 Static Balance Test 3
A-1 Aircraft Pumps 5 6
A-2 Electrical Equipment 5 6
A-3 Valves and Fittings 5
A-4 Aircraft Instruments 8 5
A-5 Landing Gear Units 2 4
A-6 Hydraulic Equipment 18 7
A-7 Heat Transfer Units 1 15 8
A-8 Radio Equipment 2 1 4
A-9 Air-Conditioning Equipment 7 5
A-10 De-Icer Equipment 6 45 7
A-11 Pyrotechniques 1 4
E-1 Carburetor Installations 18 6
E-2 Engine Accessory Drives 12 5
E-3 Magnetos 4 9 4
E-4 Sparkplugs, Shielding, etc. 5 1 5
E-5 Standard Parts 11 3 5
E-6 Screw Threads 2 20 4
E-7 Involute Splines 1 2 6
E-8 Drafting Room Practice 1 1 6
E-9 Preservation of Engines 14 12 6
E-10 Surface Finishes 1 5
E-11 Engine Performance 7 1 5
E-12 Design Data and Drawings 1 3 5
E-13 Engine Vibration 2 5
E-14 Automatic Engine Power Controls 1 3
E-15 Small Propeller Parts 5
E-16 Cold Starting 5
Generators and Starters Secret 5
Instruments Secret 7
Controls Secret 6
Low Tension Cables Secret 4
Lighting Equipment Secret 9
Connectors
Vehicle Bodies Secret 3
Chassis Secret 3
Electrical Equipment Secret 3
Engines Secret 3
Transmissions and Axles Secret 3
MOTOR FUELS DIVISION 24 71 66
(6 Subcommittees)
Full-Scale Engine Detonation 5 8 27
(3 Subcommittees)
Motor Fuel Volatility 5 10 14
(3 Subcommittees)
General (3 Subcommittees) 2 7 27
AVIATION FUELS DIVISION
Full-Scale Detonation 13 19 56
(6 Subcommittees)
Laboratory Detonation 6 10 123
(7 Subcommittees)
Vapor Lock 72 17 74
(8 Subcommittees)

ECTS of the

GOVERNMENT AGENCIES

OTHER MILITARY AGENCIES

ization

IVISION

SAE GENERAL STANDARDS COMMITTEE

Aircraft Propeller Standards

Aircraft Materials Specifications

Materials Specifications and Standards

	Projects Completed	Projects Underway	Number of Members
IRON and STEEL DIVISION	2	2	39
Steel Hardness Numbers	1	3	9
Lighting Division		1	14
Lubricants Division		1	43
NON-FERROUS DIVISION		2	
Solders	1		6
White Bearing Metals	1		11
Special Gearing Metals	1		7
Aluminum – Casting Materials	1		8
Aluminum – Wrought Materials	1		7
Magnesium Casting Materials	1		6
Magnesium – Wrought	1		8
Copper Base Alloys	1		16
JOINT SAE-ASTM TECHNICAL COMMITTEE A – RUBBER			10
1. Engine Mounts		1	10
2. Rubber Bumpers	1		10
3. Brake Hose	1		10
4. Natural Rubber		1	10
5. Synthetic Rubber	1		10
6. Automotive V Belts		1	10
7. Hardness Testing		1	10
8. Cooling System Hose		1	10
Aeronautical Screw Threads	1		11
Aircraft ENGINE Materials and Processes	8	17	17
AIR6A4ES Materials and Processes	34	43	18
Aircraft ACCESSORY Materials and Processes	206	110	11
P-1 Cuff Clearance		6	4
P-2 Clearance for Governors	1	2	3
P-3 Test Club Standards		2	2
P-4 De-Icer Connections		1	4
P-5 Dual Rotation Shafts	Secret		4
P-6 Revision of Standards	1		4
P-7 Retaining Nuts		8	4
P-8 Control of Two-Speed Gears		4	4
P-9 Static Balance Test	Secret	3	3
			3

the armed forces reduced this figure to 960 as of Dec. 31. There is every indication, however, that last year's record will be passed early in 1943.

New Student Branches

The Oklahoma Agricultural and Mechanical College, the Agricultural and Mechanical College of Texas, and the College of the City of New York were the three schools to receive Student Branch Charters from the Council during 1942. All have active organizations that are a credit to SAE. Informal SAE Clubs are established at other colleges and it is expected that several of these will petition recognition as Student Branches within the next year.

Section Cooperation

The Student Committee is grateful to the various Section Student Committees for their cooperation in furthering student activities. Sections have given full support to SAE Student Branches in their territories and several have sponsored student paper contests. The committee also wishes to express its appreciation to the faculty advisers of SAE Student Branches and Clubs who have given so much of their time to these organizations.

War Activity Council Guides Expanded SAE Program of Engineering Service to Government and Military

by B. B. Bachman,
Chairman, SAE War Activity Council

THE SAE War Activity Council continued to direct the SAE war program in 1942, supervising the mobilization of automotive engineering talent, establishing SAE war service policies, and coordinating the accelerated growth of the SAE program and staff.

By adapting existing engineering projects to war objectives and by approving inauguration of scores of new war projects upon requests from the Government and the military, WAC tremendously has expanded the SAE war program. Under direction of the various SAE technical groups, thousands of engineers now are engaged in war engineering projects of military necessity initiated at official request.

WAC correlates and coordinates these efforts so that duplication is avoided and each project can be fitted helpfully into the whole pattern of war engineering. Many projects have been carried on within the confidence of various war agencies, and, by successful and timely completion, have proved to be consequential factors in the successful prosecution of the war. So much of the work still lies within the realm of military secrecy that only a broad general report on WAC activities currently can be made, yet even so brief and cautious a review is sufficient to indicate the scope and the importance of the SAE war program.

From the original nucleus of five, WAC itself has been enlarged as the progress of war engineering work has demanded. Organization for WAC work in general has grown to proportions so great and so complicated as to be presented intelligibly only by chart. (See accompanying insert chart.)

Under the direction of WAC, practically every technical project and activity of SAE now has a war objective. While sight is not being lost of the possibility of applying wartime developments to peacetime purposes, the primary aim now is war service.

For purposes of review, this program may be said to have two basic objectives:

1. Standardization – To aid in expediting industrial war production, generally by providing engineering advice, service, and research; specifically, by developing standards and specifications for materials and products.
2. Reports and Recommendations – To aid in facilitating the military effort by making engineering reports and recommendations, and by rendering engineering service, to the military.

WAC expedites war production and facilitates the military effort by devising the ways, means, and agencies whereby war engineering projects may be carried on separately from industrial and military operations, yet be correlated, coordinated, and controlled. In effect, WAC directs and SAE war project committees provide a supplementary technological service branch upon which the military can rely, but from the operation of which it is relieved. For industry is provided a continuing and cooperative engineering advisory, research, and service effort which makes available facilities and findings of inestimable value, yet which relieves industry of a heavy burden of engineering work at a time when its full energy must be devoted to war production.

Important phase of the operations is the widespread dissemination of research and engineering data within the war-production industries. These data have enabled industry to maintain war-production schedules. Reports and recommendations to the military, while confidential, are known to be substantial contributions to the American military effort in a war which puts premiums upon time and production. A letter from Major-Gen. L. H. Campbell, Jr., U. S. A., Chief of Ordnance, dated Sept. 18, 1942, expresses the appreciation of the military, and concludes with this statement:

"The SAE is, indeed, an essential element in our war program."

Work of the various SAE engineering committees approved by WAC is tremendous in scope and importance, and is productive of results which are both tangible and intangible. Evaluation is difficult in such rapidly-changing times. An engineering effort which eased a crisis yesterday may be tomorrow's commonplace, yet it is obvious that these efforts constitute patriotic services of which SAE justifiably can be proud.

Engineering for War

Among tangible results are the 39 engineering reports and recommendations, submitted to various agencies of the Government and the military by the SAE War Engineering Board. These data have established the engineering basis for many an important wartime decision. Highly commendatory letters received from ranking Government and military officials have indicated that W. E. B. has saved vast amounts of critical materials, time, and money and has made possible the production of increasingly superior motorized war equipment.

While W. E. B. is interested primarily in engineering analyses and in conservation of materials, its work has had a much greater scope. W. E. B. serves both Governmental and military agencies, undertaking many basic engineering projects concerned with conservation of available or development of new materials for general and specific uses, and with improvement of war equipment. The 16 members of W. E. B. act as sponsors of the various projects, and select from among industrial engineers those outstanding experts qualified by experience for fundamental engineering research.

Tangible also are the 283 specifications covering materials used by manufacturers of aircraft engines, airframes, propellers, and aircraft accessories made available to the aeronautical and related industries by the SAE Aeronautics Division. Nearly 150 new SAE Aeronautical Materials Specifications have been prepared and distributed, and 130 have been revised to satisfy wartime requirements. More than 3000 different users have obtained approximately 1,500,000 copies of these specifications, which have been a helpful factor in expanding military aircraft production.

Cooperative work with the WPB Technical Advisory Committee for Aeronautical Steels has developed 16 Aeronautical Materials Specifications covering compositions of alternate steels. In cooperation with producers and vendors of synthetic rubbers, 24 specifications covering different types of synthetic rubbers used by airframe, aircraft engine, propeller, and aircraft accessory manufacturers have been prepared.

Maintaining Highway Transportation

To meet the need for maintaining essential highway transportation service in wartime and to aid operators of commercial motor vehicles in prolonging the service life of commercial motor vehicles, more than 30 committees have been created under the direction of an SAE-ODT Coordinating Committee to develop recommended practices for motor vehicle conservation. Several committees already have completed their work and have filed helpful reports. Others are actively engaged upon continuing projects related to the task of keeping in operation trucks, buses, and other motor vehicles which cannot be replaced under wartime conditions and for which, in many cases, even repair parts cannot be obtained.

This endeavor is particularly broad in scope, ranging from equipment reconditioning operations to the training of drivers and service mechanics. The bulk of this work, like that of so many of the SAE war projects, will have permanent value. Standardized service practices and operations, rebuilding of worn parts by metal-coating, safe methods of operation, storage practices, load distribution, and vehicle design and dimensions are regarded as definite contribu-

tions to more efficient highway transportation in the future.

Recent development has been the initiation of work designed to aid the Maintenance Section, U. S. Army Ordnance Department, in solving engineering problems arising with increasing frequency as the use of military motor vehicles is extended and the number in operation grows.

Engineering Advisory Services

The work of the SAE Electrical Advisory Committee has been along the lines of standardization of electrical equipment on combat vehicles. Much of this undertaking is secret, the committee having prepared for the Ordnance Department a series of specifications covering generators, lights, instruments, switches, circuit breakers, relays, cables, and connectors.

An SAE Tractor War Emergency Committee, recently organized, purposes to make engineering advice and data on wartime uses of tractors and machinery available to Governmental agencies. The committee initially is acting in an advisory capacity on tire rationing, substitution of materials, conservation of equipment, and other subjects.

Pioneering work has been done by the SAE Standards Committee in classifying and in simplifying both natural and synthetic rubbers and in preparing specifications. Additionally extensive work has been done with materials specifications, SAE participation as one of three sponsors in the WPB project for developing "National Emergency" steels having been administered by the committee's Iron and Steel Division. The Non-Ferrous Metals Division is revising SAE specifications to meet changing situations affecting these materials.

The SAE Quartermaster Advisory Committee has completed confidential work with the military, chiefly looking to the standardization of engines, chassis, bodies, transmissions, axles, and other parts of military motor vehicles.

The SAE Ordnance Advisory Committee has been doing confidential consulting work on design of power plants, transmission systems, and tracks and suspensions for tanks and other military vehicles.

The work of the Cooperative Research Council, sponsored jointly by SAE and the American Petroleum Institute, now is active in research fields on wartime fuels, lubricants, and the satisfactory use of both fuels and lubricants in equipment. The work on fuels has been placed in five divisions concerned with motor, aviation, automotive diesel, and non-petroleum fuels, and with fuels surveys. In the field of lubricants research, divisions concerned with engine oils and with chassis and transmission lubricants have been active. A lubrication research division is being organized. In the field of equipment, there have been organized general, engine, and operation and maintenance research divisions.

Mobilization of Talent

Creation of WAC in June, 1940, on the basis of war engineering experience dating back to SAE service in World War I served effectively to meet many of the critical problems arising from mechanized warfare, including mobilization of engineering talent. Never before has war made such large demands upon the engineering professions, and the role of the automotive engineer has become increasingly important with the growing production of motorized military equipment for all-out mechanized war.

The magnitude of war engineering work and the number of Governmental, military, and civilian agencies interested in the expeditious design, development, manufacture, delivery, and servicing of military motor vehicles, planes, ordnance, and other equipment obviously demanded an engineering agency which would:

1. Command the confidence of Government, military, industries, and professions alike;
2. Afford a reliable source of wartime engineering advice and service;
3. Direct fundamental engineering research and development projects related to production for war;
4. Reconcile engineering, production, and technical requirements of war equipment; and
5. Coordinate the engineering phases of the national war effort.

In the trying pre-war period, WAC was called upon to organize automotive engineers for the national war effort, to undertake basic engineering projects of military necessity, to coordinate SAE war engineering activities in such a way as to avoid duplication of effort and other waste, to advise the product divisions of the Automotive Council for War Production, and, upon official request, to assign specific war engineering projects to qualified groups for study, action, and report.

For these vitally important war services, WAC personnel comprises the chairmen of SAE Standards, Research, and Engineering Relations Committees, together with the chairmen of each of the SAE war project committees functioning under WAC. A majority of those appointed to WAC and to the agencies subsequently created by it already was engaged in SAE defense activities which, under way since 1939, were placed under WAC jurisdiction.

WAC members are:

Chairman, B. B. Bachman.
Col. Herbert W. Alden.
(Chairman, SAE Ordnance Advisory Committee)
A. T. Colwell.
(SAE representative, Automotive Council for War Production)
A. G. Herreshoff.
(Chairman, SAE Engineering Relations Committee)
L. Clayton Hill.
(Chairman, SAE Quartermaster Corps Advisory Committee on Standardization)
John H. Hunt.
(Chairman, SAE Standards Committee)
A. W. Lavers.
(Chairman, SAE Tractor War Emergency Committee)
Dr. George W. Lewis.
(Chairman, SAE Research Committee)
J. B. Macauley, Jr.
(Chairman, SAE Lubricants Advisory Committee)
Arthur Nutt.
(Chairman, SAE Aeronautics Division, Standards Committee)
Jean Y. Ray.
(Chairman, SAE Transportation & Maintenance War Advisory Committee)
James C. Zeder.
(Chairman, SAE War Engineering Board)

Standards Committee Aids Military and Government Agencies in Solving Acute Materials Problems

by John H. Hunt,
Chairman, SAE General Standards Committee

Standardization work of SAE during 1942 has been devoted primarily to problems arising in war production activities. Shortages of critical materials have determined a very large percentage of these problems.

The Aeronautics Division has been working with the Aeronautical Board and other Government agencies in preparing SAE Standards and material specifications, and in assisting the services in coordinating their proposed AN specifications with industry. Members of the services have been invited to participate in all SAE committee meetings and, in a number of instances, these meetings were devoted to constructive criticism of proposed AN specifications.

Approximately 30 circulations of proposed AN specifications have been made to the industry for comment. These comments were summarized and forwarded to the Aeronautical Board for its information in preparing the AN specification in its final form.

The following subdivisions of the Aeronautics Division are in operation with appropriate, highly specialized subcommittees functioning under each of the subdivisions:

A. Aircraft-Engine Subdivision
B. Aircraft Accessories and Equipment Subdivision
C. Aircraft-Engine Propeller Subdivision
D. Aircraft Materials & Processes Coordinating Subdivision

The accomplishments of these subdivisions during the past year may be summarized as follows:

A. Aeronautical Standards –

1. 20 new aircraft-engine standards plus four new and four revised recommended practices approved and ready for use. In addition, a revised edition of the Manual of Aircraft-Engine Drafting Room Practice was issued.
2. 2 propeller standards approved and ready for use.
3. 8 aircraft accessory standards approved and ready for use.
4. 71 standards available now.
5. 4 new aircraft-engine standards and 1 recommended practice are pending approval by the Aircraft-Engine Subdivision.
6. Drafts of approximately 60 proposed aircraft-engine standards and 12 proposed standards for propeller items are in various stages of completion and will be completed within the next five or six months.

B. Aeronautical Material Specifications –

1. 119 new specifications issued.

2. 98 revised specifications issued.
3. 283 specifications available now.
4. 30 additional new and revised specifications in process.

C. Miscellaneous –
1. 97 meetings held.
2. 37 separate committees functioning.
3. 187 individual committee members:
   39 are representatives of airplane manufacturers.
   71 are representatives of airplane engine manufacturers.
   19 are representatives of airplane propeller manufacturers.
   46 are representatives of airplane accessory manufacturers.
   6 are representatives of airline operators.
   6 are representatives of Government agencies.

NE Steel Specifications

The National Emergency (NE) steel specifications project, organized late in 1941 by OPM, started to move ahead rapidly early in 1942 under the aegis of WPB. SAE, AISI, and ASTM were made co-sponsors of the project, with the cooperation of other civic organizations and the military services.

During 1942 SAE representatives served on the Administrative Committee and on the Technical Advisory Committees on Automotive Equipment and Aeronautical Steels. The early work of the Technical Advisory Committee was directed principally toward simplification and reduction in the number of steel specifications and toward facilitating the interchange of technical information on the application of the new NE steels. Later, as critical shortages developed in various alloying materials, the NE steels compositions were revised from time to time to consume less of the critical ingredients.

In addition, the Iron and Steel Division has cooperated closely with the Iron and Steel Committee of W. E. B. since the formation of this committee in 1942.

SAE members served during 1942 on another cooperative steel standardization project – the Joint Committee on Definitions for Heat Treating Terms. Working with SAE members on this committee are representatives of the ASTM, ASM, and AFA. It is expected that the revisions in heat-treating definitions made by the Joint Committee will be published in the 1943 "SAE Handbook," as well as in the publications of the other participating societies.

All three subdivisions of the Non-Ferrous Metals Division of the SAE Standards Committee – Light Alloys, Copper Alloys, and Miscellaneous Alloys – have been unusually active during the past year. Their work has proceeded along two principal channels:

1. Extensive revision of SAE non-ferrous metal specifications to conform to latest engineering practice and to coordinate, in so far as possible, the revised specifications with ASTM specifications.

2. Development of SAE recommended "emergency" non-ferrous specifications. These emergency specifications were developed to conserve a maximum amount of critical materials in cooperation with the general materials conservation program of the WPB and the military services.

Rubber Specifications Completed

Important progress has been made during 1942 by the SAE-ASTM Technical Committee A on Automotive Rubber. Outstanding among its accomplishments are the standard specifications for automotive and aeronautical synthetic rubbers completed by Subcommittee V on Synthetic Rubber Specifications; and the standard classification and tests for natural automotive rubbers developed by Subcommittee IV on Rubber Conservation. Both standards have been approved by the SAE General Standards Committee and the SAE Council and will be published in the 1943 "SAE Handbook" with subsequent modifications.

To satisfy an urgent need for specifications on non-rigid plastics that developed among the military services, another joint SAE-ASTM committee was formed early in December, 1942. The new committee was set up originally as Section 10 on Non-Rigid Plastics of ASTM Committee D-20 on Plastics; the SAE membership will represent the automotive and aeronautical industries.

In still another cooperative project undertaken to expedite the war effort, a uniform tabulating code was developed through the joint efforts of the Army, SAE, AISI, and ASTM. The code is used to simplify and speed up the work of compiling materials reports by industry, and of tabulating and utilizing these data by military services and Government agencies. The code was developed under the direction of the Army with SAE, AISI, and ASTM acting as advisers.

Tangible results of intensive activity by the Lighting Division during 1942 have been made available for use until publication of the 1943 "SAE Handbook" in the form of a booklet which brings together recently revised and rearranged test procedures for automotive lighting equipment, SAE Recommended Practice for lamps for military motor vehicles, and all other lighting specifications. This material has been approved by the SAE Council and General Standards Committee.

In recognition of their wide usage and acceptance throughout the automotive industry, SAE Standards for wool felt, together with the complementary ASTM methods of test, have been included in the manufacturing standards, announced in 1942 by the Felt Association, Inc., governing the specification and purchase of wool felt for all important applications, including the majority of felt purchases made by the Army and Navy and Government contractors, as well as civilian industries.

The SAE Committee on Radio Interference appointed in 1941 under the Standards Committee has made substantial progress in clarifying problems and eliminating difficulties concerned with the installation, testing, and inspection of radio equipment in military tactical and combat vehicles. This progress is the result of the interchange of technical information among representatives of vehicle and equipment companies, U. S. Army Signal Corps, Ordnance Department, and Quartermaster Corps, at committee meetings and by means of questionnaires circulated by the committee.

Other notable progress made in SAE standardization during 1942 includes a revision of the 36-hr oxidation test by the Lubricants Division. The development of standard maintenance instruction cards for motor vehicles is one of the important results of SAE's expanded activities in the transportation and maintenance field. These instruction cards have been approved by the SAE General Standards Committee for publication in the 1943 "Handbook." Preparation of the 1943 "Handbook" already is under way; it will be issued as early in 1943 as conditions permit.

In addition to the foregoing, SAE continued during 1942 to cooperate in a long list of standardization work carried on by other organizations, such as the sectional committees under American Standardization Procedure, and projects in other national organizations, such as the American Society for Testing Materials, and other civic and technical bodies.

Conduct Research in Highway Safety, Riding Comfort, Vehicle Static, and Aircraft Engine Spark Plug Tests

by Dr. George W. Lewis, Chairman, SAE General Research Committee

DEFINITION of motor-vehicle accidents, measurement of friction between tire and road, preparation of a bibliography on riding comfort, and investigation of improved methods for testing aircraft engine spark plugs were among the activities of the SAE General Research Committee in 1942.

Activities under the General Research Committee were carried on by the Highways Research Committee under the chairmanship of T. C. Smith, the Riding Comfort Research Committee headed by R. W. Brown and the Ignition Research Committee under A. L. Beall.

With the formation of the Cooperative Research Council early in the year under the joint sponsorship of SAE and the American Petroleum Institute, all lubricants research activities carried on under the General Research Committee were transferred to the new Council. The committees involved in this transfer, and whose work is now being carried on under CRC auspices, include the Aircraft Engine Lubricants Research Committee, the Crankcase Oil Stability Research Committee, the Engine Wear Research Committee, and the Extreme Pressure Lubricants Research Committee.

Define Vehicle Accidents

The most important work of the Highways Research Committee in 1942 had to do with the motor vehicle accident definition work which was carried on, under the direction of the National Conference on Uniform Traffic Accident Statistics, in a committee headed by Dr. Halbert L. Dunn of the U. S. Bureau of the Census. For several years the Highways Research Committee has been working upon a Uniform Classification of Motor-Vehicle Accidents.

The Classification is in abbreviated form, which will be suitable for fleet operators

turn to page 48

Increased Revenue Aids in Meeting Rising SAE Costs As Organization's Activities Expand for War Services

by David Beecroft
SAE Treasurer

DURING the fiscal year ending Sept. 30, 1942, SAE set up many increases in its activities. It gives me great pleasure to report that additional revenue from dues and advertising has helped to offset the great increase in SAE expenditures because of cooperation in the war effort. To offset the portion of SAE war expenses that could not be absorbed by our own natural increase in revenue, SAE accepted contributions to a War Chest fund and used only such portions of this fund as were necessary to offset the deficit for the year.

The comparative Balance Sheet and Income and Expense statement are a part of this report and, in brief, show the following:

	1941-1942	1940-41
Income	$380,451.52	$322,956.81
Expense	402,923.97	284,601.98
Net Unexpended Income	22,472.55*	38,354.83

*Deficit.

During the past fiscal year, the investment portfolio of SAE was increased by $12,486.25. At the close of the fiscal year, the total book value of securities held was $256,517.26, and their actual market value on the same date was $251,454.00. These securities, all bonds, are distributed as follows: U. S. Government 42%, Public Utilities 28%, Industrials 21%, and Railroads 9%.

As is customary each year, the books of account have been audited by Haskins and Sells.

General Research Committee

continued from page 47

and others in keeping their records in such order that they will be convenient for their own use; and equally important, they will be in such form that they can be readily compared on an equal basis with the records of other fleets. The Classification has been approved to be included in the Accident Manual now being published by the Committee on Definitions. In addition, the Highways Research Committee's efforts are reflected in the participation in the work of revising the Accident Manual preparatory to making this new issue, which contains many improvements.

The study of methods for measuring the friction between the tire and the road has made some progress due to work which has been carried out by Prof. R. L. Moyer in completing an extensive road test started before the war. It is felt that analysis of these results will throw more light upon the fundamentals of the method.

The field experiments on the study of static in vehicles have been temporarily discontinued. However, the information to date has indicated the limitations of some methods of dissipating the static.

As a new project it is hoped that arrangements can be made for the Highways Research Committee to work with the Committee on Winter Driving Hazards of the National Safety Council on the use of locking differentials in passenger cars and trucks with a view to making possible safer driving and at the same time reducing the necessity for use of tire chains.

Among the 1942 activities of the Riding Comfort Research Committee have been the development of a bibliography on riding qualities, informal advisory cooperation with the Ordnance Department on combat vehicle riding comfort problems, and consideration of apparatus for measuring human tolerance to vibration.

The Ignition Research Committee continued with its investigation of improved methods for testing aircraft engine spark plugs. The results to date indicate that the proposed quench bomb test is a more severe test than the old style spark plug bomb test and is worthy of full consideration by all interested parties, particularly as regards its application to routine operating and maintenance problems by the airlines and military personnel. The work of the subcommittees on reduction of gap erosion and preignition tests for aviation spark plugs continued.

Treasurer's Report

BALANCE SHEET AS OF SEPTEMBER 30, 1942

ASSETS

Cash	$105,732.83
Restricted Cash	8,245.42
Accounts Receivable	5,351.98
Securities	258,517.26*
Accrued Interest on Securities	2,347.28
Inventories	804.05
Furniture	1,000.00
Deferred Charges	4,742.02
Appropriations Receivable	3,687.50
TOTAL ASSETS	$388,428.34

LIABILITIES AND RESERVES

Accounts Payable	$ 9,526.13
National Dues and Miscellaneous Items Received in Advance	23,229.70
Reserve for Restricted Funds	8,245.42
Reserve for Appropriations Unearned	1,229.17
SAE War Chest	87,957.45
General Reserve	258,240.47
TOTAL LIABILITIES AND RESERVES	$388,428.34

* Book Value (Market Value September 30, 1942, $251,454.00)

INCOME AND EXPENSE AND BUDGET COMPARISON
12 MONTHS, ENDING SEPTEMBER 30, 1942

INCOME	Oct. 1, 1941 to Sept. 30, 1942	Budget 1941-1942	Oct. 1, 1940 to Sept. 30, 1941
Dues and Subscriptions	$106,540.15	$96,000.00	$96,775.33
Initiation Fees	21,132.50	15,000.00	17,901.25
Affiliated Appropriations	34,624.99	35,750.00	37,813.34
Interest and Discount	8,416.11	7,800.00	7,931.06
Advertising—Journal	142,453.25	105,000.00	113,572.00
Advertising—Handbook	10,250.00	8,000.00	8,600.00
Miscellaneous Sales	52,880.17	34,000.00	36,766.55
Unused Portion of Section Dues	4,154.25	.....	3,472.28
Profit on Sales of Securities	.....	.....	125.00
TOTAL INCOME	$380,451.42	$301,550.00	$322,956.81
EXPENSES			
Research	$11,937.95	$16,850.00	$16,137.74
Cooperative Research Council	9,041.67	.....	.....
Standards	35,147.79	25,770.00	10,507.40
Publications	71,479.53	64,535.00	56,525.21
Sections	7,814.13	9,120.00	7,988.02
Meetings	20,456.98	19,280.00	13,460.30
Membership	16,342.96	16,590.00	14,317.00
Advertising—Journal	44,401.62	33,955.00	37,115.02
Advertising—Handbook	2,145.31	1,600.00	1,792.70
Miscellaneous Sales	30,114.82	12,930.00	14,939.65
General Expense	103,012.86	85,835.00	85,368.03
Engineering Relations	7,534.26	12,340.00	12,389.01
Miscellaneous Government Cooperation	12,098.45	5,000.00	14,081.82
Detroit Office	6,993.99	.....	.....
West Coast Branch Office	10,946.59	9,500.00	.....
Professional Activities	7,789.08	9,600.00	.....
Loss on Sales of Securities	5,665.98	.....	.....
TOTAL EXPENSES	$402,923.97	$322,905.00	$284,601.98
Net Unexpended Income	$22,472.55**	$21,355.00**	$38,354.83
Transferred from SAE War Chest to cover deficit	$22,472.55		

** Deficit

Reconditioning Cylinder Blocks and Fitting Sleeves

Report of Subcommittee, Maintenance Methods Coordinating Committee, SAE Transportation and Maintenance Activity, Submitted to the Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation.

IN considering cylinder sleeves, the Committee found it necessary to divide this report into three parts. They are:

A. Salvaging and reconditioning cast en bloc engines by installing dry-type cylinder sleeves.

B. Reconditioning and replacing dry-type cylinder sleeves in replaceable cylinder-sleeve engines.

C. Reconditioning and replacing wet-type cylinder sleeves in replaceable cylinder-sleeve engines.

Section A treats the subject of installing dry cylinder sleeves in an engine not designed for the use of sleeves, as a means of salvaging the engine when damage or wear to one or more cylinders makes such a step necessary.

Section B is an outline for the installation and maintenance of dry cylinder sleeves when used in an engine designed for their use and originally equipped with them.

Section C is an outline for the installation and maintenance of wet cylinder sleeves when used in an engine designed for their use and originally equipped with them.

■ A. Salvaging Cast En Bloc Engines

Taking up each division of the subject in the order stated, we can report in connection with the first division that this practice is believed to be entirely practical and advisable when any of the following conditions exist:

1. The diameter of the oversizing required will be greater than the safe maximum specified by the engine manufacturer or will necessitate the removal of more than 1/16 in. of metal from the cylinder bore, which is the limit except where cylinder-wall thickness is known to be sufficient to permit greater oversize.

Subcommittee on "Reconditioning Cylinder Blocks and Fitting Sleeves"—D. B. Erminger, chairman, assistant service manager, International Harvester Co.; E. H. Blakelock, shop superintendent, Quaker City Motor Parts; H. L. Eberts, assistant to the general manager, Small Electric Motors, Ltd.; A. W. Lines, general manager, Sealed Power Corp.; J. R. Nelan, shop foreman, County of Los Angeles, Road Department; Floyd Patras, manager of maintenance, Southwestern Greyhound Lines; E. W. Whitman, shop superintendent, K. & G. Auto Parts, Inc.; E. P. Gohn, project chairman.

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SAE Maintenance Methods Coordinating Committee—W. J. Cumming, chairman, chief, Vehicle Maintenance Section, Division of Motor Transport, Office of Defense Transportation; E. P. Gohn, test engineer, The Atlantic Refining Co.; M. E. Nuttila, superintendent, Motor Vehicles, Cities Service Oil Co.; G. W. Laurie, manager, Automotive Transportation Department, The Atlantic Refining Co.; Col. T. L. Preble, War Department, Office of Chief of Ordnance; J. Y. Ray, supervisor, Automotive Equipment, Virginia Electric & Power Co.; S. B. Shaw, automotive engineer, Pacific Gas & Electric Co.; W. A. Taussig, automotive engineer, Burlington Transportation Co.; E. W. Templin, automotive engineer, Los Angeles Department of Water & Power; D. K. Wilson, superintendent, Automotive Equipment, N. Y. Power & Light Corp.; A. M. Wolf, automotive consultant.

2. The cylinder walls are deeply scored or cracked, necessitating the removal of more than 1/16 in. of metal.

3. The porosity of the metal is such that leakage is visible under test.

Note: Despite the widespread misconception among truck users, the use of cylinder sleeves of any type has never necessitated, and does not now necessitate, the complementary use of special pistons or rings. Standard pistons and rings are entirely satisfactory.

■ Preparation for Installation of Sleeves

The paramount consideration when installing dry-type sleeves in cast en bloc engines is to obtain the best possible fit of sleeve in block. Only a close and uniform fit will assure adequate transfer of heat from piston and rings through the sleeve to the cooling section of the block.

Inasmuch as the sleeve "outside diameter" contour always conforms to the contour of the block bore and reflects any irregularities therein, it is essential that the bore of the block be as true as careful workmanship can make it. The greatest accuracy must be observed in boring and machining if distortion of the sleeve, with subsequent corrective honing, is to be avoided. The machining can be done with either a precision cylinder grinder or a boring bar. More than one grind or cut should be made to obtain the finished size.

The specification for the fit of the sleeve to the bore depends on which type of sleeve is being installed – the cast-iron sleeve of comparatively low Brinell rating (200 minimum) or the steel sleeve with high Brinell rating (460 minimum). The usual fit for the cast-iron type of sleeve is a shrink or press fit of 0.002 in. to 0.003 in., whereas a line-to-line fit is considered satisfactory in the case of the high-Brinell type steel sleeve (except in rare instances where extremely thin sleeves are used, in which cases a slightly tighter fit is necessary). Where a plain sleeve of this type is to be used, it is recommended that a shoulder be left in the bottom of the bore, in order to lock the sleeve in place between this shoulder and the cylinder-head gasket. Where it is possible to install a sleeve with a shoulder at the top to register with a groove at the top of the bore, a shoulder in the bottom of the bore is not necessary.

■ Installation Methods

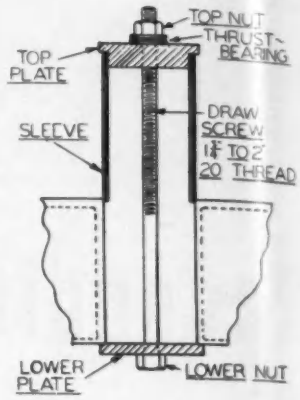
The practicability of three methods of installing dry-type cylinder sleeves in cast en bloc engines has been well demonstrated. These methods are:

1. Use of puller assembly.
2. Use of air-hammer equipment.
3. Expansion of cylinder bore and contraction or shrinkage of cylinder sleeve.

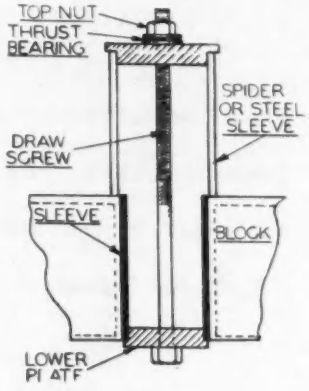
1. Use of Puller Assembly – The first of these methods, the puller method, requires that, prior to insertion in the bore, the outside diameter of the cylinder sleeve be given an even coat of thin white lead or hydraulic brake fluid. This precaution prevents scoring of the sleeve as it is pulled in.

The setup for this method of installation is illustrated in Figs. 1 and 2.

Care should be exercised to start the sleeve in squarely, in order to prevent "cocking" or distortion. It should be



■ Fig. 1



■ Fig. 2

drawn down with an even pull until it is flush with the top of the cylinder block.

When a number of sleeves are to be installed, say six, they should be installed in alternate bores as, for example, 1, 3, and 5 followed by 2, 4, and 6. This procedure, permitting the block and sleeves to normalize themselves gradually, is a safeguard against distortion, with implied complications.

Upon completion of the installation of sleeves in a block, the inside diameter of each sleeve should be measured with an inside micrometer and dial indicator for possible distortion resulting in a taper or out-of-round condition which would impede piston travel. If either condition is indicated, it should be corrected by reboring or honing.

In order to remove all abrasive particles, the installed cylinder sleeves should be washed out with soapy water, flushed with clear water, and dried with air. When dry, the cylinder sleeve should be lubricated without delay to prevent rusting.

Running clearance between piston and cylinder wall should be checked with steel ribbons or feeler blades of specified thickness and tension pull.

2. Use of Air Hammer – The second installation method, the air-hammer method, is the same in principle as the puller method just described, in that the cylinder sleeve in each case is forced into the block bore under strong pressure. The air-hammer method, however, does differ in the following detail:

To use the air hammer it is necessary to make up a

"driving" plate that will fit the inside and outside diameters of the cylinder sleeve and take the blows of the hammer. The plate must be strong enough to withstand blows of one-half the operating pressure of a small air hammer, and must be secured in some way so that it will remain in constant contact with the sleeve (to prevent damaging the end of the sleeve).

In all other respects the installation technique given in the previous section for the puller method applies throughout for the air-hammer method and need not be repeated here.

3. *Expansion-and-Shrinkage Method* – This third sleeve-installation method for cast en bloc engines differs from the preceding two in that it does not demand the exercise of force. Under this method the engine block is filled with hot water to bring about expansion or enlargement of the bores, while the cylinder sleeves are chilled by dry ice or other refrigerant to bring about shrinkage and a reduced outside diameter. Ordinarily under this method the sleeve can be installed by hand but may sometimes have to be tapped in (with a soft wood block).

Under this method, sufficient time must be allowed for the block and sleeves to normalize themselves as to temperature before the bores are checked for taper and out-of-round, and the running clearance is determined, as described in connection with the puller assembly method.

■ B. Reconditioning Dry-Type Cylinder Sleeves

It is accepted practice, when required, to oversize dry-type sleeves for larger pistons up to the limit of manufacturers' recommendations, which run from 0.040 to 0.060 in. Sleeves which cannot be oversized within specified limits definitely should be replaced.

The method of oversizing dry-type sleeves depends on the material in them. If the sleeve material has a low Brinell rating a boring bar, grinder, or hone can be used very satisfactorily. If the sleeve has a high Brinell rating, a boring bar cannot be used and the sleeve must be oversized by grinding or by use of a hone with stones of special grit. Naturally the oversizing of a high-Brinell type sleeve involves considerable work, for which reason only the minimum amount of metal should be removed.

No measurements for distortion, running clearance, and so forth, should be taken before the bore has had time to cool and normalize itself.

■ Replacing Dry-Type Sleeves

Whenever sleeve oversizing requirements exceed the manufacturers' recommendations in that respect, the sleeve should be replaced.

Pullers are available or can be made up locally (as shown in Figs. 1 and 2) which are very satisfactory for the removal of used sleeves.

It is recommended that, following removal of the sleeves, a hone with fine-cutting stones be passed through the bores of the block to polish the surfaces. The polishing not only facilitates installation of the new sleeves but assures maximum contact of sleeve to bore for most efficient transfer of heat.

Before installation the outside diameter of each sleeve should be measured to make sure it is the right size for the bore in which it is to be installed. Installation of sleeves will be further facilitated and scoring prevented if the outside surface is given an even coat of thin white lead or hydraulic brake fluid.

As the three commonly approved methods of installation have been described in detail in another section, the reader is referred to that section for particulars.

■ Reconditioning Wet-Type Cylinder Sleeves

For various reasons manufacturers of wet-type replaceable cylinder-sleeve engines have in the past been reluctant to approve the oversizing of wet cylinder-sleeve bores and installation of oversize pistons as a remedy for cylinder-sleeve wear or damage. The three main objections cited by the manufacturers are: first, the general unavailability of the skilled mechanics and precision reboring equipment necessary for a good job; second, the frequent dissatisfaction of owners with the jobs turned out as compared with a straight replacement job; and third, the much longer time the truck is "down" as compared with straight-replacement "down" time.

Today, however, owing to the necessity of conserving metal required for the country's war effort, the practice of oversizing wet-type sleeves is favorably regarded, so long as all necessary precautions are taken in reconditioning the sleeve. The oversizing must, of course, be held within the specified safe limits of 0.040 to 0.060 in., except in the case of extremely heavy sleeves, when larger tolerances are permissible.

Concerning oversizing procedure we make the following recommendations:

As experience has proved the impracticability of grinding, honing, or boring out wet-type cylinder sleeves in their original block or case, it is definitely recommended that sleeves be removed from the block and placed in a special fixture affording at least a line-to-line fit. A line-to-line fit will prevent movement of the sleeve during the operation.

It is the absence of a line-to-line fit between a wet-type sleeve and the block which makes it impracticable to oversize these sleeves in their original blocks. Clamping the sleeve at the top to prevent movement during oversizing strongly tends to distort the upper section of the sleeve while failing to prevent movement at the lower end, owing to the resilience of the rubber seal ring or gasket. Consequently, it is almost impossible to make a straight or round bore in this manner.

Removal of sleeves is accomplished by means of a puller (see Figs. 1 and 2) or a hydraulic jack or press. Usually wet-type sleeves need be forced only about one in., or until the sleeve breaks loose and clears the seal ring. The sleeve can then be lifted out by hand.

The rubber seal ring should be removed immediately, before it hardens. The ring groove should be thoroughly cleaned, as should the retaining flange and lower end of sleeve-support surfaces and the entire outside diameter of the sleeve.

To facilitate installation, the new seal ring should be coated with white lead or a mixture of heavy soapsuds and glycerin. The sleeve should then be pushed gently into place, care being taken to prevent damaging the rubber ring. In the majority of cases no pushing tool is necessary.

Finally, it is recommended that the manufacturers' instructions covering sleeve replacement be followed in all cases.

About SAE Members

K. D. SMITH, B. F. Goodrich Co. technical man who has been manager of the Washington office of the company's national sales and service division, has transferred his headquarters to Detroit. Mr. Smith, in the rubber industry since 1915, has played a prominent part in the development of the modern pneumatic tire as technical superintendent of the company's tire division, a post he held until just before the outbreak of the present war.

WALTER S. PEPER has become chief of engineering and production at Canadian American Truck Co., Inc., New York City. He had been with Smith & Gregory of N. Y., Inc., where he was sales manager.

Formerly manager of the Truck Division, The Studebaker Corp., South Bend, Ind., **CHRISTIAN PRETZ** is now assistant to the vice-president of the Aviation Division.

LOUIS G. GRAY, formerly district motor transportation officer, U. S. Government, CCC Headquarters, Littleton, Colo., is now ordnance engineer, Denver Ordnance Plant.

Formerly superintendent of maintenance, Cincinnati & Lake Erie Transportation Co., Dayton, Ohio, **ERNEST M. LUNDA** recently joined the Automotive Division of WPB as chief of Trailer & Attachment, Axle Section, with headquarters in Washington.

C. E. MORRISON has accepted a position in the Engineering Division of Chrysler Corp. of Canada, Ltd., Windsor, Ont.

Tri-State College graduate **SCOTT B. BARNHARDT** is employed in the Engineering Department of Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

ALEXANDER SATIN went from preliminary design engineer, Consolidated Aircraft Corp., San Diego, Calif., to aeronautical engineer, Willow Run Bomber Plant, Dearborn, Mich.

WALTER J. CRANE, who had been shop foreman at Pacific Highway Transport, Seattle, holds a similar position with Black Ball Freight Service, of the same city.

EARLE A. WIENER, who had been an instructor of automotive mechanics, Mansfield Senior High School, Mansfield, Ohio, is now state supervisor of northwestern Ohio, Ohio State Board for Vocational Education, War Production Training for Defense Workers.

I. H. FINKLER and **A. H. EASTON** were recently promoted from assistant engineers to associate automotive engineers, Automotive Branch, Proof Division, Aberdeen Proving Ground, Md.

HARLEY W. DRAKE has left his position of superintendent of equipment, Pacific Highway Transport, Seattle, and is now general manager of Renton-Bothell-Seattle Stage Lines, Inc., Renton, Wash.

DON M. COURTRIGHT is project engineer of Western Gear Works, Seattle, Wash. He leaves the Puget Sound Navy Yard, Bremerton, Wash., where he was junior marine engineer in the Machinery Division.

CLAUDE A. FLEETWOOD is principal instructor of skilled trades at the U. S. Army Ordnance Automotive School, Fort Crook, Neb. He was formerly assistant general manager and consulting engineer of the Fort Dodge Machine & Supply Co., Fort Dodge, Iowa.

H. W. BUTTERBAUGH is with Basic Magnesium, Inc., New York City, having left the American Brass Co., Kenosha, Wis., where he was assistant manager.

Formerly fuels technologist for the Socony-Vacuum Oil Co., Inc., New York City, **THOMAS L. APJOHN** is now senior aviation specialist, Office of Petroleum Coordinator for War, Washington.

CARL F. BLAKELY has been transferred from position of test inspector at the Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., to become a trainee in the installation department of the corporation.

New President

Dr. Thomas Midgley, Jr.

The American Chemical Society elected **DR. THOMAS MIDGLEY, JR.,** vice-president of the Ethyl Corp., as president for 1944, it was recently announced. In 1922 Dr. Midgley discovered tetraethyl lead as an anti-knock agent, making possible advances in automotive and aircraft engines. He has also been associated with developments in the chemistry of rubber and methods of synthesizing rubber.

At a recent meeting of the Board of Directors of the Holley Carburetor Co., Detroit, **M. J. KITTLER** was elected a vice-president of the company. Mr. Kittler will also continue his previous duties as chief engineer of the Aviation Department. Since its organization, Mr. Kittler has been a member of Subcommittee E-1, carburetor installations, SAE Aeronautical Division.

DANIEL G. JEWETT is superintendent of equipment, G. Krueger Brewing Co., Newark, N. J.

FREDERICK C. CRAWFORD, president of Thompson Products, Inc., an official of many commercial and industrial associations, was elected to the presidency of the National Association of Manufacturers at the

Frederick C. Crawford

association's annual convention in New York recently. In 1916 he joined the company which ultimately became Thompson Products, Inc., and has been president of this company since 1933, and of the Thompson Aircraft Products Co., a subsidiary.

PIERRE SCHON has joined the Marmon-Herrington organization, where he will do special experimental engineering work in motor transportation. This new assignment brings Mr. Schon back north after several years in Florida, where he went to enter the field of truck distribution after many years in sales engineering with the General Motors Truck & Coach Division, Yellow Truck & Coach Mfg. Co.

Formerly chief research engineer, Vultee Aircraft, Inc., Vultee Field, Calif., **ERNEST G. BRUCE** is now assistant chief engineer of the Airplane Division, Edward G. Budd Mfg. Co., Philadelphia.

R. F. SCHAEFER has left his position of research engineer in charge of the New Research Laboratory, National Supply Co., Springfield, Ohio, and is now an engineer with the Aluminum Co. of America, Cleveland.

VAN WYCK HEWLETT, who had been tool and machinery designer, E. W. Bliss Co., Brooklyn, N. Y., has joined Snead & Co., Aeronautic Division, New York City, as a checker of glider drawings.

HERMAN P. FRUEHAUF has been made general foreman of the Isaacson Iron Works, Plant No. 1, Seattle, Wash., where they are manufacturing forgings, trac dozers, ship propeller shafts, and numerous small supplies. Previously Mr. Fruehauf had been production foreman, Kenworth Motor Truck Corp., Seattle, Wash.

JOHN LLOYD RICHMOND is now in the engineering department of the Bendix Products Division, Bendix Aviation Corp., South Bend, Ind., having left the employ of the Cooper-Bessemer Corp., Mt. Vernon, Ohio.

Formerly administration engineer, Crosley Corp., Cincinnati, **ALEX J. JUNKER** is now assistant director of the experimental and development division, Libbey-Owens-Ford Glass Co., Toledo, Ohio.

WILLIAM H. WATKINS is the newly-appointed factory manager of The McKinnon Industries, Ltd., St. Catharines, Ont., a subsidiary of General Motors. Mr. Watkins has been connected with the industry for 30 years, joining General Motors in 1933 and rising from general superintendent and assistant factory manager to his present post.

William H. Watkins

EDGAR J. DOUGLAS is an electrical draftsman with the Austin Co. of Midland, Mich. He was transferred from the Cleveland office of the company.

ORIN L. ROMIGH, formerly general foreman of inspection for the military area, Remington Arms Co., Inc., Bridgeport, Conn., has joined the Chrysler Corp., Detroit, as an engineer.

PHILIP RUSKIN, a member of SAE since 1927, is now on the editorial staff of *Diesel Power & Diesel Transportation*. He was formerly with Commercial Filters Corp. of Boston, as research and consultant engineer.

ERNEST J. STOCKUM is now sales manager of the Dayton Malleable Iron Co., Dayton, Ohio. Mr. Stockum, who is chairman of the Dayton Section, was formerly in the sales and estimating department of the G. H. R. Foundry Co., also of Dayton.

WILLIAM J. PERRY has been appointed administrator of Machinery and Tools Sub-Unit, Technical Control Branch, Inspection Section, U. S. Army Air Forces, Materiel Center, Wright Field, Dayton, Ohio.

Formerly with the Hudson Motor Lines, Inc., Charlotte, N. C., JAMES G. HAYDEN is now director of conservation of Associated Transport, Inc., New York City, which was recently formed through the merging of Barnwell Bros., Southeastern Motor Lines, Transportation, Moran Transportation Lines, McCarthy Freight System, Consolidated Motor Lines, and Horton Motor Lines. He is in charge of personnel, and the safety and conservation of all vital materials.

FREDERICK HAROLD CORP is no longer chief inspector of Canadian Pacific Airways, St. Hubert Airport, Quebec. He is now an inspector in the marine department of John Inglis Co., Ltd., Toronto.

At a recent directors' meeting of the Asbestos Mfg. Co., Huntington, Ind., FRANKLIN C. EDSON was elected president and general manager of the company, and E. H. JANES was elected a director.

IGOR I. SIKORSKY, noted aircraft designer and engineer, has been doubly honored for his achievements in aviation by the Institute of the Aeronautical Sciences. He has been elected an Honorary Fellow of this organization, and has been chosen to receive its annual Sylvanus Albert Reed Award for 1942. Mr. Sikorsky is engineering manager of the Vought-Sikorsky Aircraft Division of United Aircraft Corp., Stratford, Conn., with which he has been associated since 1928.

ALBERT C. KELLY has severed his connection with Carl L. Norden, Inc., New York City, to become tool designer and checker for Burchell Products, Inc., of the same city.

LESTER F. CAMPBELL has been transferred from Pratt & Whitney Aircraft Division of United Aircraft Corp., East Hartford, Conn., to the Pratt & Whitney Aircraft Corp. of Missouri in Kansas City. He is now factory manager.

Formerly transportation maintenance superintendent of Peacock Dairies, Inc., Bakersfield, Calif., JOHN B. CLARK is now a civilian technical automotive adviser in the U. S. War Department, Camp San Luis Obispo, Calif.

LLOYD D. BEVAN, who had been research engineer at the Continental Aviation & Engineering Corp., Detroit, is now experimental assistant engineer on liquid-cooled project at the Lycoming Division, The Aviation Corp., Williamsport, Pa.

CHARLES E. CHAMBLISS, JR., is regional expediter in charge of the New York Section of the New York Army-Navy Electronics Production Region. This agency handles the production, management and expediting of radar and radio equipment. Mr. Chambliss had been senior production engineer, U. S. Army Signal Corps, Philadelphia.

JACK A. NELSON recently accepted the position of diesel representative with the Sales Technical Service Department of the Standard Oil Co. of Indiana. His former position was that of automotive engineer in the Des Moines division of the company.

DONALD D. WALLER has been transferred from the position of development engineer to that of staff engineer, Consolidated Aircraft Corp., and has gone from the San Diego plant to Fort Worth, Tex.

BLYTHE R. JONES, who had been assistant division manager of the Ethyl Corp., with headquarters in Boston, has been named research engineer, and is now in Detroit.

FLOYD GARDNER is now employed by the Los Angeles City Schools as an instructor of automotive subjects. He had been automotive shop teacher at the Frank Wiggins Trade School, Los Angeles.

KARL H. EFFMANN has been made supervisor of engine testing at The Perfect Circle Co., Hagerstown, Ind.

RAYMOND M. DOUGLAS recently left the Pioneer Engineering & Mfg. Co., Detroit, to accept a position with the Besser Gun Co., Division of the Besser Mfg. Co., Alpena, Mich. He is vice-president in charge of engineering and production methods.

B. D. Kunkle

The following appointments were announced by General Motors recently: B. D. KUNKLE, vice-president in charge of the manufacturing staff, assumes the additional duties of group executive over Cadillac, Oldsmobile, Pontiac, Canadian and Overseas Divisions; WILLIAM A. WECKER, who has been president and general manager of McKinnon Industries, St. Catharines, Ont., becomes vice-president and general manager of General Motors of Canada.

William A. Wecker

EMERY B. KEREKES holds the position of chief research engineer with the Eliott Mfg. Co., Milford, Conn., having left the Szekely Engineering Co., Inc., Philadelphia.

JEROME LEDERER is executive assistant in the Airlines War Training Institute, Washington. Mr. Lederer had been director of the Safety Bureau, Civil Aeronautics Board, Washington.

Formerly experimental engineer, Cleveland Tractor Co., Euclid, Ohio, **RALPH C. CHESNUTT** is at present a product engineer with the Hydraulic Equipment Co., Cleveland.

OTTO MUELLER has severed his connections with the Murray Corp. of America, Ecorse, Mich., where he was chief engineer, and is now consulting engineer for Widman Mueller Engineering, Detroit.

EDWARD D. HERRICK is president of the Linn Mfg. Corp., Morris, N. Y. Mr. Herrick was formerly technical manager of the Scintilla Magneto Division, Bendix Aviation Corp., Sidney, N. Y.

Formerly instructor of aircraft engines, Casey Jones School of Aeronautics, Newark, N. J., **J. K. HONIGMAN** is now with Ranger Aircraft Engines, Farmingdale, L. I., N. Y., where he is director of publications.

JAMES C. McROBERTS recently changed his position from project engineer at The Buda Co., Harvey, Ill., to assistant project engineer, Lycoming Division, The Aviation Corp., Williamsport, Pa.

ADOLPH MOSES is now chief tool designer of the International Mutoscope Reel Co., Inc., Long Island City, N. Y. He has been designer and draftsman for the General Instrument Corp., Elizabeth, N. J.

EDWIN W. WHITMAN is no longer superintendent of machine shop, K. & G. Auto Parts, Inc., Brooklyn, N. Y., having left this position to join Republic Aviation Corp., Farmingdale, L. I., N. Y., as survey engineer in the Subcontract Division.

Chester E. Mines

CHESTER E. MINES, resident chief engineer, Jacobs Aircraft Engine Co., Pottstown, Pa., is chairman of the Engine Subdivision, SAE Aeronautical Standards Division, succeeding **VAL CRONSTEDT,** resigned. Mr. Cronstedt was named chairman in March, 1941, when the Division was reorganized.

Appointment of **ARTHUR A. TURTON** to the position of chief engineer of the Harvill Corp. has been announced by F. M. Hoefler, president of the firm. Mr. Turton has been with this organization for nearly a year, and prior to his new responsibilities he was in charge of research and development in the capacity of consulting engineer.

Col. Paul Weeks

Col. Paul Weeks, for many years associated with The Holt Mfg. Co. and Caterpillar Tractor Co., died in Kenwood, Md. Dec. 20. Upon completing his engineering training at the University of Nebraska and the Massachusetts Institute of Technology, he entered the employ of the Baldwin Locomotive Co., traveling extensively in South America. When he returned to this country he engaged in copper mining activities in Arizona and then joined The Holt Mfg. Co., of which he later became chief engineer. During World War I Col. Weeks was an officer in the Ordnance Department. After the war he joined the Fageol Co., and shortly thereafter became service manager for its eastern affiliate, The American Car & Foundry Co. Col. Weeks first joined the Caterpillar Tractor Co. as general service manager, continuing in that capacity in Peoria until several years ago when he was transferred to the company's offices in Washington.

Harte Cooke

Harte Cooke, diesel engineer and senior engineer of the Diesel Division of the American Locomotive Co., died on Dec. 14 after a short illness. He was 71 years old. Mr. Cooke, who until his illness served as an instructor of Navy men stationed at Cornell University, was a member of the National Defense Research Committee, and during the last war was a member of the U. S. Shipping Board. He was associated with American Locomotive for more than half a century. Mr. Cooke had lectured at many colleges and universities, and was regarded as one of the foremost diesel engineers in the world. He was graduated as a mechanical engineer from Rensselaer Polytechnic Institute, and held posts with W. W. Cooke & Sons, the Cohoes Foundry and Machine Co., and McIntosh & Seymour Co.

SAE Member Bags 260-Lb Buck

Photo by Jack Manning from Black Star

One fine eight-point 260-lb buck recently fell to the arrow of **JULE MARSHALL,** vice-president of the American Felt Co., an experienced archer and woodsman.

At 7 a.m., Nov. 29, Mr. Marshall with two other bowmen, Karl Staley, illumination engineer, General Electric Co., and Lawrence Gerry, hydraulic engineer, Worthington Pump Co., entered a valley between Yorktown and Sparkle Lake in Westchester County. They planned to work by fanning out a quarter-mile apart. Mr. Marshall took the slopes to the left, over a marsh and a trout stream, then a climb some 100 ft above the valley. He reached a clearing on a plateau with dense second growth beyond. While studying the terrain he noticed a movement about 70 yd ahead. Freezing to study, he saw it was a big buck moving upward and to his left.

There was a low five-ft cliff to one side. Mr. Marshall moved laterally toward it, and under its cover advanced 30 yd toward the deer which, sensing danger, had slowed down to a walk. Mr. Marshall knew he would have trouble getting an arrow through all those small trees, so he sought a corridor and found one about two ft wide. The buck had frozen with his head up and breast toward the hunter. There was no time now to check the 21 things an archer must do correctly – all that he had ever learned and practiced had to go into this shot. The distance was estimated at 40 yd, the elevation at 15 deg. The sight was set, and the arrow was off straight as a die. It deflected on a sapling in front of the buck and took a wide arc course to the right. The fidgeting buck turned to watch it, exposing his flank. In another instant the second arrow was in his heart. A 27-yd run and the buck was dead. The arrow travelled 42 yd, cut two ribs on the near side, severed the main artery at the heart, buried 13 in. deep after partly cutting the ribs on the far side. Cleaned, drained, and dressed, the buck weighed 196 lb – a big animal.

Mr. Marshall, an SAE member since 1922, was instrumental in the development of SAE felt specifications, and also headed the original committee of the ASTM, which finished the test methods for felt, including the standard method for testing thickness, which has been adopted for many other materials.

Photo by U. S. Army Signal Corps. Courtesy Fairchild Engine & Airplane Corp.

SAE members are prominent in this picture of the American mission of aviation manufacturers to England. They are watching for the return of Flying Fortresses from a raid over France. Left to right: I. M. LADDON, Consolidated Aircraft Corp., A. G. HERRESHOFF, Chrysler Corp., J. C. WARD, JR., Fairchild Engine & Airplane Corp., Major Thomas Hitchcock, U. S. Air Forces, CHARLES MARCUS, Bendix Aviation Corp., G. D. WELTY, Aluminum Co. of America, P. G. Johnson, Boeing Aircraft Co., T. P. WRIGHT, Aircraft Production Board, WPB, Sidney Stewart, Hamilton Standard Propellers, William K. Ebel, Glenn Martin Co.

In Military Services

BYRON FOY is in the U. S. Army Air Forces, Officers' Training School, Miami. Mr. Foy had been vice-president of the Chrysler Corp.

BRIG.-GEN. JOHN K. CHRISTMAS recently became assistant chief of the Tank-Automotive Center, Detroit. A veteran of 25 years in the Army, he will be executive officer of the organization, charged with responsibility of development, manufacture, procurement and maintenance of tanks and other motorized equipment.

CAPT. ROBERT W. HOGAN, Ordnance, recently completed an officers' course at Aberdeen, Md., and has been assigned to the Maintenance Branch of the Tank-Automotive Center, Detroit. Capt. Hogan had been with The Ethyl Corp.

LT.-COM. H. W. RISTEEN, USNR, formerly in the Bureau of Yards & Docks, Washington, has been sent on foreign duty.

Formerly commanding Company A, U. S. Army Infantry, 1st Parachute Training Regiment, Airborne Command, Arlington, Va., **CAPT. JOHN G. Mac'KIE** is now at the Parachute School in Fort Benning, Ga.

CAPT. CARROLL A. McSHANE is in the U. S. Army, Ordnance Department, Motor Transport Service, and is stationed in Detroit. In civilian life Capt. McShane was a fleet engineer for the Electric Auto-Lite Co. of Toledo.

HUGO EDWARD GILLE is no longer an engineer in the laboratory of the Wright Aeronautical Corp., Paterson, N. J. He is now a lieutenant (jg), Naval Reserve Aviation Base, Pasco, Wash., where he is flight instructor and aircraft maintenance officer.

Formerly lubrication manager, West India Oil Co., Buenos Aires, Argentina, **LT. ROBERT H. MILBRATH,** USNR, is now assistant naval attaché at the U. S. Embassy in Buenos Aires.

CAPT. CLARK ANDERSON FISHER is an engineering officer in the U. S. Army Air Forces, 28th Company Group, Seattle, Wash. He had been assistant base engineer, U. S. Army Air Corps Air Base Headquarters, Fort Richardson, Alaska.

MAJOR J. RUSSELL WALSH has been transferred from the U. S. Army, War Department, Office of the Quartermaster General, Washington, to Headquarters Services of Supply, and can be reached through A. P. O. 871, New York, N. Y.

Formerly a major in the U. S. Army, Tank & Motor Transport Branch, Office of Chief of Ordnance, Arlington, Va., **CARL E. CUMMINGS** is now a lieutenant colonel in the Ordnance Department, Engineering Branch, Tank-Automotive Center, Detroit.

KEITH C. ALLEN, formerly special representative, British American Oil Co., Ltd., Toronto, Ont., Canada, was appointed to the Canadian Army recently. He is a lieutenant, Directorate of Mechanical Maintenance, Royal Canadian Ordnance Corps.

RUDOLPH BURNEY WATSON, JR., who had been commanding officer, Coast Guard Reserve, Boca Grande, Fla., is now with the War Shipping Commission, U. S. Maritime Service, and has been assigned to administrative duties aboard the U. S. Maritime Training Ship American Seaman.

Formerly a lieutenant, R.N.V.R., in charge of maintenance and repair of American aircraft with the Royal Navy, **JOHN HUMPHREY MILLAR** is now a lieutenant commander. He is assistant senior naval representative in the Royal Navy Office, Bureau of Aeronautics, Navy Department, Washington.

CAPT. J. W. FERGUSSON is with the 1st Canadian Base, Royal Canadian Ordnance Corps, Canadian Army Overseas. He had been a lieutenant in the RCOC, stationed at Kingston, Ont., Canada.

LT. CURTIS M. JESTER is motor officer, Company B, 73rd Ordnance Battalion, at Camp Barkeley, Tex. He was formerly stationed at Fort Sam Houston, Tex.

Formerly technical and service representative, National Carbon Co., Pittsburgh, Pa., **LT. J. E. SCHIPPER, JR.,** is now at Camp Sutton, N. C. He is in charge of training engine specialists, both radial and in-line, for wheel vehicles, half tracks and tanks. Lt. Schipper, formerly of the Metropolitan Section of SAE, is a former field editor for the *SAE Journal*.

LT.-COL. FELIX DORAN, JR., who had been general manager of the Fleet Division, General Motors Corp., Detroit, has entered military service, and is in the Ordnance Department.

DONALD C. WIMBERLY is now on

leave from the Standard Oil Co. of Calif., where he was research engineer in the Research & Development Department, and is now a lieutenant in the U. S. Army. Lt. Wimberly is stationed in Australia.

Formerly major in the Royal Army Ordnance Corps, **M. A. McEVOY** is now a lieutenant colonel in the Royal Electrical & Mechanical Engineers, England.

MAJOR HARRY O. MATHEWS has been transferred from the Quartermaster Corps of the U. S. Army, Washington, to the Ordnance Department, Tank-Automotive Center, Detroit.

COL. FREDERICK C. HORNER is chief of the Highway Division, Transportation Corps, Services of Supply, Arlington, Va.

FABIO SERGARDI, stationed in the U. S. Army Signal Corps, Fort Monmouth, N. J., has been transferred from head standards consultant to head mechanical engineer.

Iowa State College graduate **MORRIS G. MUNSON, JR.,** is a second lieutenant in the U. S. Army Air Forces, Portland Army Air Base, Ore., where he is an engineering officer.

CAPT. BRENTON W. JENNINGS, formerly manager of the lubrication department, Utah Oil Refining Co., Salt Lake City, Utah, is in the U. S. Army, Headquarters Ninth Service Command, Fort Douglas, Utah. He is in the Automotive Maintenance Section.

CLYDE H. MITCHELL, U. S. Army Air Forces, resident representative, Curtiss-Wright Corp., Airport Plant, Buffalo, N. Y., has been promoted from major to lieutenant colonel.

OSCAR C. THOMAS is U. S. Technical Service Representative, General Motors, Ltd., Argyll House, 245-250 Regent St., London, W.1, England. Mr. Thomas had been diesel service engineer, General Motors Overseas Operations, Detroit.

Formerly in the Office of Chief of Ordnance, Tank & Motor Transport Branch, Washington, **MAJOR LEO KRISL** has been transferred to the Tank-Automotive Center, Engineering Branch, Detroit.

WALTER S. FORTNEY, formerly student engineering officer, U. S. Army Air Forces, Air Service Command, New Orleans Army Air Base, La., has been promoted to first lieutenant, and is now with the 77th Service Squadron, Hunter Field, Savannah, Ga.

MAX H. SCHACHNER recently received a commission as major in the Signal Corps of the U. S. Army, and was appointed acting chief of the Automotive and Power Branch, Fort Monmouth Signal Laboratory. Previously Major Schachner was technical chief of the Automotive and Power Section.

Formerly sales engineer, Continental Oil Co., Ponca City, Okla., **FRED B. HUNT** is now an officer candidate, U. S. Army, Aberdeen Proving Ground, Md.

GORDON J. CUSHMAN is in the U. S. Army Air Forces, Baer Field, Fort Wayne, Ind. He was formerly stationed at Wright Field in Dayton, Ohio.

Formerly sales manager of marine equipment, Glenn L. Martin Co., Baltimore, **CLARENCE H. SCHILDHAUER USNR,** is now a commander. He is located in the Navy Building in Washington.

GEORGE GOODRICH LAMB, Bureau of Aeronautics, Navy Department, Washington, was promoted from lieutenant to lieutenant commander.

C. W. SPRING, formerly technical assistant manager, lubrication department, Shell Oil Co., Inc., San Francisco, has accepted a commission as senior lieutenant in the U. S. Naval Reserve, and has been assigned to the Office of Inspector of Naval Materials in San Francisco.

ROBERT E. JEFFREY, JR., U. S. Army, Ordnance Department, Washington, was recently promoted from lieutenant to major.

Transfer of **CAPT. FRANKLIN R. NAIL** recently took place. He went from Office of Quartermaster General, Motor Transport Division, Engineering Branch, Washington, to the Tank-Automotive Center, Detroit.

CAPT. D. W. SMITH, JR., who was formerly a lieutenant in the 182nd Field Artillery, Fort Leonard Wood, Mo., is now in Headquarters 8th Air Force, and can be reached through A.P.O. 633, New York, N. Y.

ASHTON K. STONE, Office of Inspection of Petroleum Products, U. S. Navy, Philadelphia District, is now a lieutenant (jg).

HAROLD POLLARD, former squadron leader and chief technical officer, Royal Canadian Air Force, No. 8 Repair Depot, Winnipeg, Man., Canada, has been made deputy chief inspector of accidents. He is wing commander.

WALTER LINCOLN HARDY, U. S. Army Air Forces, who had been a lieutenant in the Materiel Division, Experimental Engineering Section, Wright Field, has been promoted to captain, and transferred to the Engineering Division, Department 57.

Formerly squadron leader and chief engineer, Royal Air Force, 34th Elementary Flying Training School, **JOHN BURT FLYNN** has been made squadron leader and commanding officer of the Servicing Squadron, 36th Service Flying Training School, Alberta, Canada.

Cites Power of Ideas

L. C. Goad, left, Charles F. Kettering, right

This war is teaching us – and Hitler – that ideas are pretty powerful things, **CHARLES F. KETTERING,** vice-president of General Motors Corp. in charge of research, and a past-president of the SAE, told a "progress report" ceremony of the Eastern Aircraft Division of General Motors recently at Linden, N. J.

L. C. GOAD, general manager of the Division, had invited reporters and editors to visit the Linden, N. J., plant of the Division and see the production of Grumman Wildcat fighters and Avenger torpedo bombers for the Navy.

The Division is composed of five GM plants along the Eastern seaboard, and has a total of 60 acres of floor space devoted to fabricating and assembling these airplanes. It was organized about a year ago.

Other General Motors executives who participated in the celebration were **ALFRED P. SLOAN, JR.,** chairman of the board, and **C. E. WILSON,** president.

SAE War Engineering Meeting

continued from page 34

***American Combat Vehicles*—COL. E. L. CUMMINGS, Army Ordnance Department.**

AMERICAN combat vehicles on foreign battlefronts and in production are equal or superior to those of the Axis from the standpoint of those essential characteristics of firepower, mobility, and protection. With the continued assistance and cooperation of industry, this superiority will be maintained.

This was the conclusion reached by the author, who gave a resume with illustrations of the development of American and German tanks, and analyzed some of the salient successes and critical shortcomings of the designs he showed.

He assured his audience that the battlefront experiences and engineering ingenuity of civilian and military engineers working on "next year's models for an earlier-than-scheduled showing" are combining to make the American "combat team" a destructive force where destruction means winning.

Col. Cummings pointed out that there had been genuine team work in developing this "combat team" of motorized equipment between the Army and industry, and cited the work of the SAE Ordnance Advisory Committee, headed now and since the last war by Col. H. W. Alden. He estimated that about 25,000 civilian engineers and draftsmen are now engaged full time on developing better and building present equipment for the Ordnance Department.

Added to these facilities, are the major proving grounds of the automotive industry, he pointed out, where death on wheels and tracks is being given their development workouts and trial proofs.

His analysis of the improved firepower of tanks and armored cars for the past two years, and particularly during the past 12 months, showed important achievements. His report of mobility showed the relative obsolescence of equipment which was the world's best only a short time ago as compared with the newest types on the battlefronts today. He indicated that greater improvements, of which the security of military information prevented disclosure, are in the offing. Protection has been increased, along with the foregoing factors, he said in explaining the difference between what was considered excellent only a short time ago and what is in production.

Service Conditions Faced by Military Vehicles—LT.-COL. JOSEPH M. COLBY, Ordnance Department, U. S. Army.

IMPORTANT among the reasons why the M3 medium tank, called the General Grant by the British, has been a successful weapon, is that every subassembly in the unit can be taken out by an average working crew in a half day, Col. Colby disclosed. This accessibility has gone far to make this tank one of the most devastating units in the war to date, he said.

Likening a combat force to a football team, the author showed the importance of proper maintenance to mobility, the key of modern warfare. "The principles of war do not change," he said. "Security, reconnaissance, mass movement and reserve hold their same importance. The only thing new in this war is speed," he declared.

The colonel was an official observer of the battles in the Middle East theater of war, and cited numerous examples of the superiority of American-built tanks. He established maintenance schools where British soldiers were taught how to keep American tanks in action.

Supply of parts in the field of battle, he pointed out, was basically a problem of training mechanics, supply of ordnance and repair parts, and maintenance. Thus the officer in charge of supply must have these three functions under his control.

Sources of supply were from the zone of the interior; from "cannibalism," where usable parts were stripped from equipment that did not warrant repair; and from local manufacturers. In Egypt this source was not satisfactory. He found that the supply of proper tools was one of the most aggravating problems of motor equipment maintenance at the front.

Training of mechanics presents few problems provided competent instructors are assigned to do the teaching. "The importance of clear, simple maintenance and operation manuals cannot be too highly stressed," he said.

***Production Experiences With NE Steels*—R. W. ROUSH, The Timken Detroit Axle Co.**

HOW the metallurgists of industry have been forced to develop virtually a new series of National Emergency (NE) steels because the original specifications were outmoded by the huge demand on molybdenum, was explained by the author, whose services as a member of the working committee and whose company have been in the forefront of this metallurgical wonder of all time.

Development work, which would ordinarily have taken some 10 years, was crowded into a space of a few weeks. A feature of the work was digging into old files which otherwise might have gathered dust until dumped into the ash can. The interchange of information between users and steelmakers set a new high for voluntary cooperation. But the author warned that the present level of knowledge is based only upon laboratory tests and must be proceeded upon with caution.

The NE 9420 appears to be satisfactory, Mr. Roush said, as a substitute gear steel for the former NE 4120, and may probably be used as a substitute for the NE 4620 specification. However, it does not appear to be warranted as a substitute for the NE 4320 or NE 4820. For these, he reported, the NE 8720 does appear to be satisfactory.

In the water-hardening structural grades, the NE 8630 can be substituted for the NE 3130 and 4130.

SAE Past-Presidents Arthur Nutt and D. G. Roos put the SAE War Engineering Production Meeting on the air, discussing war engineering problems, jeep prospects, and aviation developments, over Detroit's WJR. They were first anniversary guests of the "In My Opinion" round-table hour, Sunday, Jan. 10. Left to right: Mediator George Cushing, Mr. Nutt, Announcer Bob Guest, Mr. Roos, and Commentator Royce Howes

E. A. Clark, chairman SAE Ammunition and Artillery Meetings Committee, and two of the officers who spoke during the three sessions arranged by Mr. Clark's committee. Left to right: E. A. Clark, Budd Wheel Co.; Lt.-Col. H. R. Turner, Ordnance Department; and Col. H. H. Zornig, Ordnance Department

Physical properties of NE 9430 approach those of NE 8630, and physicals of NE 9442, including torsion, appear comparable with NE 4140.

Experience shows that NE 8739 to 8749 have been good substitutes for both NE 3135 and 4140, but these are getting to a very low moly content and their five points reduction means a good deal at this low level. The author believed that the retention of the NE 8720 for a number of gears and carburized parts was good judgment.

He recommended a Brinell of from 200 to 400 would be required for the NE 9600 series, which appears from tests thus far made, to lack ductility. Careful and improved heat treating will be required to make up for some of their inherent weaknesses.

A great deal of more work will have to be done before designers can be sure of the newest substitutes for substitute steels, he concluded, but counted this effort to save critical materials a factor in winning the war.

DISCUSSION

When questioned from the floor, Mr. Roush said that, although experience with these new NE steels had not been sufficient to make a definite answer, data to date indicate that there would not be much effect on tool life. Furthermore, he said, experience will probably show how changes in tooling practice might overcome any shortening in tool life found at the outset.

He praised the energetic work of the SAE War Engineering Board in making important contributions of research and results of development in this program.

Substitute Materials – Have We Gone the Limit? – JOHN G. WOOD and R. F. SANDERS, General Motors Corp. (Presented by Mr. Wood.)

TAKING their audience behind the scenes of materials substitution, the authors concluded that engineers have not gone the limit, and are ready to accept further challenges to their design and production ingenuity.

War production, they pointed out, cannot wait for time-consuming service tests. Accelerated laboratory tests to measure durability of parts made from substitute materials have been widely resorted to throughout the automotive industry. They described in detail "stroking test" equipment in which sample parts are stressed to destruction.

Definite cycles to failure are first established by testing to destruction parts made of the original material. This is done by averaging a number of samples. Then samples of the same part, made from substitute materials, are tested. When early failure occurs, redesign is resorted to in order to strengthen the part, or some other form of production finish is adopted.

Often, the authors pointed out, minor changes, such as increasing the radii of fillets, overcome weaknesses of parts. In the case of steering knuckles and other highly stressed parts, shot blasting has been resorted to to improve fatigue life.

In disclosing the drama of engineering minutia which is helping to win the war by conserving materials, the authors noted a number of instances where ingenuity brought actual improvements in the end product. Quality cannot be sacrificed in armament, and whether the substitution idea stems from the drawing board or laboratory or shop, careful tests are required to demonstrate the worthiness of the proposed change.

On the Army 4 x 4 1½-ton truck substitution has been made in materials for 353 items, all of which have been or are being tested.

"Our progress from this point on will depend entirely upon the supply of materials as to how far we must go," they believed. Despite restrictions, American automotive engineers can produce implements of war that will more than match the enemy's, they concluded.

DISCUSSION

Mr. Wood warned the audience that there is no flat rule-of-thumb for using the new emergency steel specifications. He pointed out that the wide experience of the SAE steels has resulted in dependable yardsticks for the designer, and that the production man has become acquainted with their use. The result of this practical experience and dependability upon published physical characteristics must await actual production and service or ballistic tests.

AMMUNITION & ARTILLERY SESSIONS

Chairmen

C. L. Patterson — **K. C. Plasterer** — **E. A. Clark**

Headed by E. A. Clark, Budd Wheel Co., a newly-created Ammunition and Artillery Meetings Committee arranged three sessions which featured up-to-the-minute production and design data about the products and problems currently most important in our war effort.

If civilian engineers on the home battlefronts of production wondered about Army and Navy close limits on specifications and tolerances, these sessions answered many a question.

Reasons for accuracy were told in plain anecdote from the battlefields of Libya, Egypt, Bataan and the trackless expanses of the Pacific and Atlantic Oceans by men who had been there, and been there fighting.

Civilian engineers who have been pioneering in metallurgy and metalworking on Army and Navy contracts, and have applied both new techniques and tried manufacturing methods to armament, explained in detail how they had solved problems which none believed could have been answered so soon after the declaration of war.

An important sidelight, clearly seen as the background of the papers and engineering discussions, was this: "Are we doing well enough to counteract what the Axis might be doing?" This was clear at the open sessions as well as those parts of the meetings that were off the record.

Steel Cartridge Cases—LT.-COL. H. R. TURNER, Ordnance Department, U. S. Army.

AMERICAN industry, and the automotive industry in particular, were given unstinted praise by the author for the development work entailed in making artillery shells from steel. Due to the scarcity of copper and zinc, the Ordnance Department began to investigate the possibilities of making cases of steel more than six months before Pearl Harbor. Today about 50 companies are manufacturing steel shells for the Army, using four processes. Millions of dollars are being saved in materials and labor on this program, the author estimated.

The only difference among the four methods, the colonel said, are the steps taken to form the cup of steel from which the shell is deep drawn. Three methods produce the cup by hot working. The Buick Motor Division, General Motors Corp., forges the cup in two operations; Ingersoll Steel & Disc Division, Borg-Warner Corp., heats a disc and rolls it in circular rolls to produce a portion of the conformation prior to cupping; and McCauley Metal Products stamps a cup from hot steel.

Without the form of the cup, he said, it is extremely doubtful that successful steel cartridge cases would ever be made. As a matter of military necessity, he said, he could not disclose the reasons for the form of the cups.

Many engineers have at one time or another attempted to fabricate steel cases by assembling various units. This was to avoid a deep draw to close specifications. The author described some of these attempts. Many attempted to develop lock-joints which, in some cases, depended entirely upon mechanical joining. Others resorted to attaching a steel cylinder to a steel base by welding, by brazing, or by riveting. Some proposed the use of steel and brass.

Among the other companies mentioned by Lt.-Col. Turner as having contributed to the early pioneering of this dramatic program were the Corcoran-Brown Division, Electric-Auto-Lite Co., Cincinnati; American Fork & Hoe Co., Cleveland; American Rolling Mill Co., Middletown, Ohio; Chase Brass & Copper Co., Euclid, Ohio, and Bowen Products Corp., Ecorse, Mich.

More than 70 engineers, from these and other companies, have been working on the project which is headed by the Cartridge Case Industry Committee of the Ordnance Department.

DISCUSSION

Details of the chemistry of steels used, cold working problems, painting, and use of shells were discussed by Col. Turner within the limitations of censorship.

After elaborate testing of many heats of special steel, it was decided that the SAE 2500 series of low carbon was the best material. However, every effort must be made to keep the steel clean during the heats at the mill.

Any production line making brass shells needs to add but one more press when using steel, he said. Most of the brass-working machines are capable of being used. However, tooling is still a serious problem, and great care is being taken of the draw dies and rings in every plant.

As in many other drawing problems, a wide range of lubricants has been used, from complicated compounds to everyday "milks" and in one plant ordinary washing soap. Session Chairman C. L. Patterson pointed out that one of the functions of the compounds was to cool the dies, and doubted that a dry lubricant would suffice.

A phenolitic varnish is used to paint the shell. Its effec-

Some of the Army Officers Who Spoke at the Meeting

Major James A. Richardson, III, Ordnance Department

Lt.-Col. C. E. Cummings, Ordnance Department

Lt.-Col. T. B. Holliday, Army Air Corps

tiveness depends upon baking for a rather long time. The shell must be cleansed carefully before applying the varnish, and the film must be as thin as possible yet maintain a continuous coating. The thickness specification of between 0.0004 and 0.0005, cited by one of the discussers, was said by Col. Turner to be a mistake and elimination of this requirement was promised.

Col. Turner thought that the varnish probably served as a dry lubricant in ejecting the shell after firing. However, it is essential that the varnish be baked hard so that no gummy residue be left in the gun breech after firing.

This huge production engineering project will serve the automotive and other metal-working industries in good stead after the war is over, because of the many simple things learned in the development of the project, he said. The speed of the development precluded opportunities to study reasons for a number of techniques or analysis of some of the phenomena, he said. "But the automotive industry will find that steel makers will know more about making steels than they ever did, and shop superintendents and foremen will be able to do things which up to now have been thought to be impossible," he said.

The paper prepared by R. B. Schenck, Buick Motor Division, General Motors Corp., was withheld from presentation by the Army Bureau of Public Relations. Its data are available to authorized persons through the Ordnance Department, and it is anticipated that the paper may be available for publication in the SAE Journal at a later date.– Editor.

***Specifying Surface Finishes in Gun Manufacture*– HAROLD S. WHITE, Oldsmobile Division, General Motors Corp.**

WITH a set of slides, the author described the company's method of controlling surface finishes produced by 50-odd subcontractors building gun parts. The system employs reference bars, finished to the required surface smoothness, and finish photographs of the actual part. These bars are based upon the Ordnance Department reference standard blocks, and the photographs are reproductions of the part, each cross-hatched in standard designs indicating surface finishes, keyed as follows:

FF, requiring the finest grade of machine finish for ordinary bearing surfaces;

F, machine finish of good quality, mated, non-rubbing surfaces;

CF, coarse machine, chipping, or coarse-grind finish,

FG, fine-grind finish for important bearing surfaces and those carrying heavy loads, and

G, coarse-grind or file finish for smoothing up and improving the appearance on an unmachined surface.

The reference cross-hatching appears at the bottom of each part photo. These photos show all surface of the part by disclosing two or more views.

Thus the finish bar and part photos form a history of all surface changes during the production run, which is kept as an integral part of the engineering and drafting record.

In conclusion the author said that this system has provided a satisfactory and complete control of all parts, and promoted a mutual understanding between the company, subcontractors, and the Army Ordnance Department.

DISCUSSION

Without the use of these sample or reference bars and the parts photographs, the company could not have used subcontractors to build this gun, Mr. White said during the discussion.

When asked why the subcontractors did not use profilometers or other measuring devices, he said that these were not available in sufficient number and that few of the subcontractors could be expected to have personnel trained to make such measurements.

Col. E. L. Cummings, Ordnance Department, and Lt.-Col. J. M. Colby, Ordnance Department

The sample bars were made by Oldsmobile, taken to the Army Arsenal, and reworked to satisfy the officers there. Then duplicate sets were made, on the same machines and under the same conditions, to simulate the master bars.

***Material Application in Gun Manufacture*– M. F. GARWOOD and E. H. STILWILL, Chrysler Corp. (Presented by Mr. Garwood.)**

HOW automotive engineers transposed Swedish blueprints from the metric to the American system, analyzed available steels for building the Bofors 40 mm anti-aircraft gun, and redesigned a number of parts to permit greater materials and manufacturing economy, were described in detail by the authors.

Exhaustive tests showed that SAE 4340 and SAE 4140 sufficed for most of the parts. These included the design of special testing machinery to simulate, as closely as possible, the service requirements of the gun. Later, however, tests were made demonstrating that a shift to NE steels could be made.

An example of engineering ingenuity, described in some detail by the authors, was the fabrication of the gun forecasing weldment. This was originally specified to be made from a steel casting with tensile strength of 32 long tons per sq in. minimum, and elongation 18% minimum. Inability to secure sound castings, and failure to develop sources for a sufficient quantity of centrifugal castings, resulted in the present design. The part is made from ½ in. SAE 1025 plate blanked, formed, and welded into a tube. Welded onto the gun, the result is believed to be even more satisfactory than the original Swedish design.

Another substitution, which proved to be an improvement upon the prototype, was the use of cast copper silicon to save tin where bronze had been specified for the bushings and bearings of the weapon. Again a reduction was made in critical materials when, after extensive experimentation and testing, bearing members were metal sprayed.

A great deal of work, the authors pointed out, was done on springs. This phase of the work required complicated acceptance tests.

Reports from field engineers on performance of the guns under actual fire, and reports from Government sources, have been most gratifying to date, the authors reported. However, development and research is being continued to improve the weapon, and at the same time to incorporate changes which will permit of more economical and more rapid production of the Bofors.

***The Why of Shell Metallurgy Specifications*– COL. H. H. ZORNIG, Ordnance Department, U. S. Army.**

RANGE and accuracy of high explosive shells are functions of design, whereas safety depends both upon design and metallurgical requirements. The factor of safety established is that not more than one shell body in about 1,250,000 rounds shall be the cause of pre-

mature functioning within the gun – a tolerance of high accuracy for any mechanical product.

The factor of safety depends upon strength, uniformity, and freedom from defects of all kinds, the author stated. Low firing stresses of mortar shell permit use of low-strength alloys which may be processed by several methods. To assure soundness, however, shell used in rifles larger than 40 mm must be produced from forged billets, carefully inspected for soundness.

Economy in the use of strategic materials has dictated the use only of manganese for alloying effects. Hence strength and uniformity must be secured by quenching and tempering.

However, because of the quantities involved, small caliber shell for automatic weapons must be manufactured on automatic screw machines of cold drawn bars. Sulfur is permitted to assist machinability.

DISCUSSION

Despite the billions of rounds of shells made during the history of military use of explosives, Col. Zornig said in response to queries in discussion, no one understands the details of the phenomena that take place at the moment of the rapid burning of the charge within the case. The period of burning, he estimated, was about 0.05 sec, but no one knows the shape of the pressure curve. Nevertheless, experience has led to certain specifications which are required for efficient firing and safety to the gun crews.

As the bursting charge of a high explosive shell explodes, the projectile has a tendency to peel laterally like the skin of a banana.

In answer to a question, Col. Zornig said that a uniform wall thickness in a cast shell is essential. This requires a special foundry set-up. For example, the core must be formed around a mandrel to assure concentricity.

Methods and Metallurgy of Shell Manufacture **– C. L. EKSERGIAN, Budd Wheel Co.**

URGENCIES of war have telescoped almost overnight manufacturing developments which in normal times would have required years to achieve, the author pointed out in his paper which recounts near-miracles of ingenuity.

Among the practices which have passed beyond the incubator stage, but have not achieved universal acceptance, was induction heating of the work in forging shell. Induction heating being a phenomenon of increment progression, those annulae lying nearest the source are heated quickest. As the recalescent point is reached, with the resulting loss of magnetism, further temperature rise is restricted. In the meantime, heat transfer by conduction proceeds, producing a uniform temperature throughout. Thus the width of the heat band can be controlled.

He traced a characteristic stress cycle as observed under internal decremental heat treatment. It provides simultaneously both hardness and ductility, a byproduct of which was successful salvaging of all rejects in a run of 175,000 90 mm shell. Important savings of strategic materials have already resulted from use of induction heating by using steels of lower chemistry than would have been required otherwise.

A remarkable achievement was cited by the author in cold heading the 50 caliber armor piercing shot core with a hardness of tool steel. Thus a large quantity of critical machine tools were saved for other war manufacturing and superior performance was attained.

Welding, brazing, and casting techniques, some in the realm of rather nebulous experimental work, were described.

DISCUSSION

Some experience has been had with round cornered square billets in forging steel shells, it was brought out in discussion. However, because of the flat sides of the section, manufacturers attempting this operation should call upon forge machinery manufacturers for detailed information. Mr. Eksergian pointed out that because of shortage of rolling mill equipment to produce a sufficient quantity of round billets, more manufacturers would probably be called upon to use the round cornered squares.

The author expanded on the practice of heating quenching oil, in response to a question as to whether an oil of lower viscosity would suffice instead of heating an oil of higher viscosity. The speaker said he was sure that the body of the heavier oil has an important effect on quenching, and his experience was that heating the quench bath was the solution to fast, even quenching.

Induction heating for production must be cooled, and the author believed that most equipment is water cooled. Pressure of 30 psi suffices, but a cooling control valve is needed to assure the cooling of the heater. A 3-in. bar can be heated to sufficient temperature in a 2-min cycle, he said.

On account of its characteristics of controllability, cleanliness, and speed, he predicted wider use of induction heating in arms manufacture and in post-war production.

Capt. A. S. Wotherspoon, USN, assigned to the Navy Bureau of Ordnance and in charge of Chrysler, Pontiac, and the Hudson Naval Arsenal, gave an off-the-record talk about naval gun control, explaining the elements of training Navy gunnery officers, and lessons learned during the last and present wars to date.

PRODUCTION SESSION

Arnold Lenz, Chairman

How the automotive industry has succeeded in retooling for armament manufacture was told by a military and a civilian authority on production.

Many of the details of design and engineering of the equipment being built for the Army were withheld by the speakers because of the exigencies of the war.

Ordnance Production Program and the Automotive Industry **– BRIG.-GEN. JOHN K. CHRISTMAS, Tank-Automotive Center.**

DESIGN and development of new combat vehicles, at unprecedented speeds and with excellent results, were credited to engineers of the automotive industry by Gen. Christmas. "To me, this is the greatest accomplishment of the automotive industry and more particularly of its engineers and managers who are represented by the SAE," Gen. Christmas said.

Along with this work, he praised the Society's efforts in work on conservation of critical materials, further simplification of Army Ordnance designs, and high grade management in scheduling and getting the most results out of the least facilities and materials.

The flexibility of automotive engineers to meet the ever-changing fluidity in design brought on by war, have involved widespread changes of design, changes in production goals, and the consequent changes in materials and manufacturing facilities. This, he said, would have to continue and he expressed confidence that these changes would be made by automotive engineers even more rapidly.

"We soldiers in effect play paper dolls for 20 years, and then are suddenly confronted with the real thing. Only in battle can the real test of fighting equipment be made," he said.

"There is developing in the automotive industry the new science of tank engineering which will take its place alongside the aeronautical and shipbuilding industries. And if we learn our lessons properly, this will keep us from having wars in the future.

"It is with a great deal of pleasure that I say the automotive industry and the Society of Automotive Engineers have joined the Ordnance Department," he said.

A moving picture was shown of some of the Army vehicles which have been fighting overseas.

The Conversion of Plants of the Automotive Industry to War Production **– JOSEPH GESCHELIN, Chilton Publications.**

UNSELFISH cooperation in the pooling of hard-won technical information on design and manufacture and an almost 100% participation in the production of the weapons of war, is the conversion record of the automotive industry as reported by Mr. Geschelin.

Since most public discussion has centered about the vehicle producers, Mr. Geschelin stressed the equally remarkable, but relatively unknown, record of accomplishment of the parts makers. The majority are converted to war production 95 to 100%, and most of them have been contributing their services to the Armed Forces for at least 18 months and a fair proportion for as long as three years.

There is an obvious reason why the parts makers have been able to make such a good showing. "For one thing," said Mr. Geschelin, "in the great majority of individual operations, it was evident that the war effort would best be served by continuing with the production of the same character of product. To cite specific examples, it may be noted that a producer of engines, engine valves, crankshafts, pistons, piston rings, electrical equipment, carburetors, and so forth, could serve best by continuing the same specialty."

By the same token, Mr. Geschelin emphasized, a proper appraisal of the situation made it evident that the producers of other types of peacetime accessories should make their conversion along the lines of the "know-how" of the organization, within the limits of existing equipment and facilities. Thus, we have major body builders engaged in the making of elements of big airplanes – wings, tail surfaces, fuselage sections, and engine nacelles.

Specialists, such as the piston-ring makers, are also making their contribution. Mr. Geschelin related an interesting story about the cooperation that has come about among the various ring makers as a result of the war. Before the war the art of making rings was a closely guarded secret, but when an unprecedented demand for airplane rings taxed the capacity of the specialists, the leading producers banded together, pooled their information, and proceeded to make it available to others. Blueprints, production information, and even manufacturing equipment were exchanged.

But what economic gains will come from this war program with its expenditures running into astronomical figures? Mr. Geschelin cited a few examples. We have learned that lower-priced steels can do the job formerly assigned to high-priced alloys. The vast expansion of airplane production has brought an entirely new concept of surface finish, surface perfection, and dimensional tolerances. Precision thread grinding, formerly almost a laboratory process, is now a common procedure in most plants. Literally hundreds of other machine tool developments have come into being during the emergency.

Research endeavor throughout the industry has also expanded into a veritable flood. It has covered design. it has touched on machine shop practice, it has expanded our knowledge of cutting tools and cutting fluids, it has vastly increased our store of information on metallurgy.

"The integration of all of these accomplishments," concluded Mr. Geschelin, "will go far to make the post-war car a better product – more economical, longer-lived, and unquestionably lower priced."

FUELS & LUBRICANTS SESSIONS

Chairmen

C. H. Baxley ★ **C. M. Larson** ★

Petroleum technologists were called upon by Army speakers to increase their efforts to keep motorized equipment rolling on the battlefields of the world, and reports of recent work in fuels and lubricant technology indicated that this group of SAE members have their sleeves rolled up at two Fuels and Lubricants sessions.

Army spokesmen were enthusiastic in their praise of SAE cooperation, both through the Society and by individual members – many of whom are serving as officers and civilians in the Army and Navy today.

New light was thrown on baffling problems by laboratory and service reports in one of the most important series of contributions to the technical literature in the field.

The Army Requirements of Fuels and Lubricants – BRIG.-GEN. WALTER B. PYRON, Chairman, War Department Committee on Liquid Fuels and Lubricants.

EXPLAINING the numerous compromises resulting in the choice of 80-octane fuel for all ground automotive equipment, as an example of the program of fuels and lubricants specifications, Gen. Pyron said that the Army Ordnance Department is now making experiments with hopes of writing a new specification for this fuel combining the A and B grades. The fuel, he said, will be designed to eliminate starting difficulties and at the same time prevent vapor lock.

Not only has global war made it necessary to provide fuels and lubricants for aircraft and ground vehicles and vessels of every description in unprecedented quantities, he pointed out, but these petroleum products must serve in the extreme ranges from sub-zero to extremely high temperatures.

To save shipping space, which was at a premium even before the declaration of war 13 months ago, it has been necessary to reduce the number of grades and types of fuels and lubricants. Furthermore, our Allies have been forced to change their specifications of these products to conform with American specifications because often the same fuel drum serves all the armed forces of the United Nations.

In this program members of the SAE were warmly praised by the General. He enumerated many laboratory tests, engine block tests, and field tests on many different specifications of fuels and lubricants, conducted by the engineers of the automotive and petroleum industries, and the value of the reports received from Army engineers on the field.

The author cited as a remarkable achievement the fact that a large number of different types of fuels, lubricants, and greases have already been reduced one-half in some cases, and to two-thirds in others. Although this relieves refiners of making numerous grades, many basic and expensive readjustments in manufacturing processes and equipment were entailed. But the Army has been relieved of burdensome transportation and distribution problems thereby.

In combat operations, he pointed out, the Army uses these four types of engine fuel: 80-octane gasoline, 87-91 octane gasoline, 100-octane aviation gasoline, and diesel-engine fuels. In the face of these reductions in the types of fuels, not only are the factors of extreme temperature to be met, but the very design of much of the armored equipment induces great heat in the tropics and extremely low temperatures in the arctic regions. Furthermore, the equipment is a weapon and must carry heavy guns and ammunition, as well as its fighting crew. To protect these men a minimum of ventilation is provided in order to give the crews as much protection from enemy fire as possible.

DISCUSSION

Major James A. Richardson, III, of the Army Ordnance Department, outlined the organization of the department, and explained the functions of the Field Service Division under Brig.-Gen. H. R. Kutz in some detail. This division of the Ordnance Department is charged with the storing, issuing, inspecting, altering, modifying, and maintenance of all Ordnance equipment after it has been manufactured and accepted. The automotive phases of this division are mostly centered in the Tank-Automotive Center, Detroit, except that the field service for fuels and lubricants is coordinated in Washington.

The Ordnance Department, to date, has standardized these fuels and lubricants: diesel fuel, 80-octane gasoline, all-purpose engine oil in three grades, two grades of gear lubricant, summer and winter chassis lubricants, and wheel bearing grease. Standardized nomenclature, embodying SAE viscosity or NLGI consistency numbers, has been developed. Another completed project is standardized containers to facilitate handling fuels and lubricants, the Major said.

At temperatures above freezing, the Army uses SAE 30 oil in practically all liquid-cooled engines; SAE 50 for all aircooled engines; SAE 90 gear oil in all automotive cases except in gear boxes of tanks which require SAE 50 engine oil.

When sustained below-freezing temperatures are encountered, he said, SAE 10 engine oil is used in all liquid-cooled engines, and SAE 30 in aircooled engines. No. 80 gear oil and No. 0 chassis lubricant are used. Wheel bearing grease is not changed because of temperature, except under extremely hot conditions where leakage occurs.

Major Richardson described the work that has been done on the preservation of engines, parts, and other mechanical equipment in shipment and storage. He expressed appreciation in behalf of the Ordnance Department, for the assistance of the Society and its individual members in helping on this program. "We will continually need your assistance, especially now with the growing Field Service job," he said.

Influence of Engine Adjustment and Octane Number on Performance of Commercial Engines – **D. P. BRENZ, H. H. MAXFIELD, and A. B. CULBERTSON, Shell Oil Co. (Presented by Mr. Culbertson.)**

GASOLINES of as low as 70 octane number can be used in commercial engines with only slight losses in power and economy, provided proper spark-timing adjustments are made; no major engine changes, such as changes in compression ratios, are necessary. This was the reassuring information that Mr. Culbertson had for operators of commercial automotive equipment.

In order to obtain a complete picture of the relationship between fuel octane number, engine adjustments, and engine performance, the authors carried out a comprehensive investigation to obtain:

1. Octane requirements for border-line knock, using standard timing.
2. Influence of spark timing on octane requirements, power output, and fuel consumption.
3. Influence of carburetion on power output and fuel consumption.
4. Allowable spark timing for various octane-number commercial gasolines using normal and over-rich carburetor mixtures.
5. Road anti-knock behavior of commercial gasolines of 66, 70.5, 77, and 81.5 octane number.
6. Influence of octane number on actual service operation, as noted by drivers. This was carried out by alternately using a 65 octane "third grade" and a 72 octane "regular grade" gasoline in normal transport service.

So that the tests would be truly representative, nine trucks of recent model and 2¾- to 4-ton rated capacity were used, and the major portion of the work was conducted under carefully controlled, heavily loaded conditions in highway operation.

Mr. Culbertson pointed out that the most satisfactory method of compensating for reductions in octane number is the same one that is used for passenger cars, namely retarding the spark timing; however, in the matter of performance, commercial engines differ from passenger car engines. Mr. Culbertson stated, "Light to medium detonation can normally be tolerated in passenger car service, whereas in commercial operation a light knock will increase to preignition conditions under prolonged full-throttle operation. In the engines tested no appreciable improvement in power or economy resulted from advancing spark timing from the basic timing specified by the manufacturer, but in passenger car engines, the basic timing is often retarded 5 to 10 deg from the maximum setting because of detonation requirements. This indicates that the use of fuels having octane ratings above the octane requirement (at basic setting) of the engine may give no improvement in performance in commercial engines."

DISCUSSION

The effects of retarding the spark, A. M. Rothrock, National Advisory Committee for Aeronautics, said, or decreasing the compression ratio, or enriching the mixtures, or decreasing the octane requirements of an engine, are essentially the effect of decreasing the density and temperature of the gas in the knocking zone.

Enriching the mixture lowers the temperature of the gas in the knocking zone, partly through the heat required to vaporize the fuel, but chiefly through changing the course of combustion so that fuel burns to CO rather than CO_2.

"Retarding the spark has the same effect basically as lowering the compression ratio. The cycle efficiency decreases slowly at first as the spark is retarded from the optimum and then more rapidly. The products of combustion, and therefore the heat of combustion, are not changed. The result is that the octane requirement of the engine can be markedly decreased without materially decreasing the fuel consumption or the power.

"Retarding the spark is a much simpler procedure than decreasing the compression ratio and therefore is to be preferred. Lowering the engine temperature would decrease the knock requirements somewhat, but does not appear to be a practical procedure," he said.

Effect of Altitude on the Knocking Tendency of Engines – **DONALD B. BROOKS, National Bureau of Standards. (Paper presented by Dr. H. K. Cummings, National Bureau of Standards, in the absence of Mr. Brooks.)**

FOR an automobile having a requirement of 70 octane gasoline at sea level, the change in requirement is about 3½ octane units per in. of hg, the author reported, as a result of extensive testing made in an altitude chamber at the National Bureau of Standards.

This is in agreement, within experimental errors of road testing, with the value of 3.1 octane units of lead per in. of hg established by Neil MacCoull, K. L. Hollister, and R. C. Crone in 1936.

The author pointed out that engine conditions, such as speed, spark advance, mixture ratio, coolant temperature, and amount of carbon deposit can be regulated. On the other hand air pressures, air temperature, or atmospheric humidity cannot be controlled in either road tests or in service. Of the latter group, air pressure can cause the greatest variation in octane number requirements.

Mr. Brooks concluded that it was probable that the variation of octane number requirement with altitude is independent of the engine used. Variations, he said, should be correct within the experimental error in road testing, in any case.

Corrosion of Bearing Alloys – **L. M. TICHVINSKY, U. S. Naval Engineering Experiment Station.**

THE replacement of tin-base bearing alloys with alloys containing less critical materials, is one of the unheroic but important problems brought on by the war. Mr. Tichvinsky's contribution to the solution is a most comprehensive series of experiments on eight bearing alloys, some having a tin base and some using various likely substitute materials.

Tests to determine the corrosion resistance of the various bearing alloys to straight mineral, additive-type, and re-refined lubricating oils were carried out in the Underwood oxidation apparatus. Most of the experiments were run for 40 hr at the standard Underwood temperature of 325 F.

Setting up a corrosion demerit rating, based on the weight loss in grams per hour, the author evaluated, on a strictly numerical basis, the overall corrosion resistance of the eight bearing materials. The tests confirmed fully the high corrosion resistance of tin-base babbitt; but they also showed low-corrosive properties for lead-base babbitt containing arsenic or silver: an encouraging result with the present scarcity of tin.

Bearing alloys that have a tendency to corrode at elevated temperatures should be lubricated with low-corrosive oils and adequate cooling provided to impede the oxidation of the oil. Mr. Tichvinsky's tests showed further that there must be a careful selection of additives, if they are used, in order to diminish the corrosiveness of the uncompounded oil.

Other properties as fatigue strength, compression, and hardness at elevated temperatures, and heat conductivity should also be considered. Mr. Tichvinsky cautions, in the selection of the proper bearings for heavy-duty operation.

DISCUSSION

Mr. Tichvinsky's findings, plus wartime shortage of tin, will stimulate use of tinless and low-tin-antimony bearing alloys, even in the post-war period, said C. H. Hack, of National Lead Co. He recommended that bearing materials be grouped by relative weight losses.

John K. Anthony, of Cleveland Graphite Bronze Corp., predicted the findings would accelerate the trend toward greater use of lead-base babbitts, but warned that a change in bearing materials should not be accepted as a cure-all. Every application deserves careful engineering study and tests before final adoption. Mr. Anthony said his own experiments have revealed lead-base characteristics practically equivalent to Mr. Tichvinsky's findings with tin-base and have indicated that lead-base babbitts are as satisfactory as arsenic and silver alloys. He proposed that, to avoid

confusion, weight losses be measured in milligrams per unit area, such as the 9.3 cm unit used in Penn State tests.

A written discussion prepared by C. J. Livingstone and R. J. S. Pigott, of Gulf Research & Development Co., and presented by Mr. Livingstone, commented that the experiments could have been made to better advantage with an engine or mechanical set-up incorporating a loaded bearing. The first three conclusions were said to be in agreement with experience, but the fourth conclusion and supporting data would be more useful if corrosion tests were made in an apparatus in which the bearing was subjected to loads, rubbing conditions, and temperatures, which would emphasize mechanical and metallurgical properties of bearings – factors affecting the tendency of bearings to corrode.

Data which might be construed as indicating that additive type oils are more corrosive were questioned. Additives improve one property of oil at the expense of another, such as inhibitors against corrosion by sea water increasing oil corrosivity at extremely high temperatures. Experiences confirm Tichvinsky findings that a satisfactory re-refined oil can be further improved and made non-corrosive by compounding with a suitable additive, but it is difficult to determine when an oil is satisfactorily re-refined. It takes as much technical skill to make a good heavy-duty oil from reclaimed oil as it does to produce the virgin oil.

Disagreement was expressed with Tichvinsky data showing that a 40-hr Underwood test at 325F is equivalent to 70 hr of service in the General Motors Model 671 diesel engine, it being the expectation that any oil passing 25 to 40 hr in the Underwood test would be satisfactory as regards bearing corrosion for more than 500 hr in the diesel test. Neutralization number was held to be no measure of the corrosivity of an oil. Distinction was made between chemical tests and satisfactory engine operation, since chemical inspection of oil removed from an engine does not indicate what has happened to the engine.

"It seems hard to convince either oil men or design engineers that the principal solution of bearing problems lies in the design of the bearings and the lubricating system and not to anything like the same extent as changing the oil. It is perfectly obvious, after the mass of experimental data that has been presented before SAE, to see that the major cause of both fatigue and bearing corrosion even with sensitive alloys, is high temperature; therefore, it becomes increasingly plain that the best cure for the situation is to reduce the bearing temperatures. This means simply designing for more oil flow over bearings and proper cooling of the crankcase oil. . . . The time is upon us when we must absolutely consider adequate oil cooling and oil flow over the bearings as the designers' responsibility and we had better face it instead of shirking it."

A. F. Underwood, of General Motors Corp., expressed the opinion that the demerit rating of bearing materials is not entirely satisfactory, and suggested the need for metallurgical study. Tin and antimony, as well as arsenic, in small quantities, will stop lead corrosion, whereas silver appears to have no effect.

F. W. Kavanagh, of Standard Oil Co. of Calif., pointed the need for correlation of machine and service tests. He said that neutralization number and bearing corrosion do not always check. Corrosion can be controlled by a proper choice of temperatures, metallic catalysts, and rate of oxidation.

Mr. Tichvinsky explained that the percentage loss in weight type of measurement had been used because bearing samples were not always adequate, and said that weight loss in milligrams was not disregarded even though the tables presented demerit ratings based upon weight loss per unit of time. He agreed that engine tests are more desirable, but it was found possible to make Underwood tests in far less time, and in this effort to discern trends, time-saving was considered essential.

***Piston Ring Scuffing as a Criterion of Oil Performance* – GEORGE H. KELLER, Wright Aeronautical Corp.**

CONDITION of engine parts after testing under standardized procedure, is the only satisfactory evidence for comparing the lubrication qualities of different oils, the author concluded, showing the detailed set-up for such engine testing.

Of seven pertinent operating variables, all except cooling conditions and oil supply were held constant. The five were power, speed, fuel mixture strength, detonation, and design of cylinder, piston, and ring.

Because experience has shown that detonation can destroy satisfactory cylinder lubrication and lead to excessive wear and ultimate failure, fuel of iso-octane – 0.8 cc T.E.L. (Aviation Test Method) was used for most of the test work reported. A Cooperative Universal engine fitted with a Wright Cyclone C9GC production cylinder and piston assembly, 6⅛ x 6⅞ or 202½ cu in., was used.

Prior to the test the cylinder barrel was lapped with Minnesota 3M compound No. 500-2-A, with an old piston and old rings as the lapping surface. This was to eliminate any surface deposits from the previous test. The oil system and interior of the engine were flushed with solvent naphtha and then with the oil to be tested. A fresh charge of oil was used for the run-in and for the test itself.

Combined researches of metallurgists, petroleum chemists, and engine designers during the past 10 years, the author said, has resulted in an engine with a 100% increase in power output, a 50% reduction in specific weight, and a 20% reduction in specific fuel consumption.

DISCUSSION

Paramount difficulty in testing oils was held by A. M. Rothrock, of National Advisory Committee for Aeronautics, to lie in finding something to measure. Test engines were said to be less than entirely satisfactory as research equipment. Questions were raised as to what degree the Keller tests reproduce themselves, to what extent test operations have been checked with full scale.

Arthur W. Pope, of Waukesha Motor Co., expressed the opinion that these tests will encourage the use of C.U.E. engines for test purposes, and demonstrate that results can be obtained.

M. O. Teetor, of Perfect Circle Co., said the results indicate the possibility of reasons other than inadequate lubrication for piston ring scuffing and feathering.

Dr. Robert I. Stirton, of Union Oil Co. of Calif., suggested that blowby might be a factor, and asked to what extent blowby had been observed.

British practice is to look for ring-sticking rather than scuffing, according to T. B. Rendel, of the British Mission. American use of wedge-type rings, as opposed to British use of parallel-sided rings, was suggested as the cause of scuffing. Opinion was expressed that it is easier, especially under field conditions, to develop an oil which will prevent ring-sticking than one which may prevent scuffing, and the job ordinarily may be done more handily before the engine goes into actual use.

A. L. Beall, of Wright Aeronautical Corp., said ring sticking is a matter of engine design which should be corrected.

Mr. Keller reported that reproducibility is possible in the tests and that consistent results have been obtained in multiple tests. He reported almost exact correlation between test operations and service performance. Blowby,

found to become bad when rings begin to fail, increased rapidly after a period to the point of actual ring failure. Ring-sticking was said to be caused by piston design.

***The Influence of Lubricating Oil Viscosity on Cylinder Wear* – H. A. EVERETT, Pennsylvania State College.**

RESULTS of tests to determine the influence on ring and cylinder wear of one single property of lubricating oil,[2] namely viscosity, were reported by Prof. Everett.

The tests were made with oils ranging in viscosity from lighter than SAE 10 to SAE 70. Special precautions were taken to eliminate all other variables. To avoid differences in crude source and methods of refining, which might have influenced performance, two blending oils conventionally refined from the same basic stock were used. By blending these in different proportions, the necessary range of viscosities was obtained. Each oil was tested for eight hours in a battery of six single-cylinder engines operating under conditions artificially controlled to closely simulate moderately heavy duty road operation of automobile passenger car engines.

Prof. Everett measured the amount of iron wear in the cylinders, by evaluating the iron contamination of the crankcase oil used, adjusted to allow for the oil that had been lost by consumption, leakage, and samples.

The results of Prof. Everett's tests showed clearly that cylinder and ring wear, and incidentally oil consumption, in well-lubricated engines decreases progressively with increasing viscosity throughout the range tested, the wear being almost inversely proportional to the kinematic viscosity.

DISCUSSION

H. C. Mougey, of General Motors Corp., said in a written discussion that the SAE viscosity grade recommended for use in a specific engine should not be based upon the Everett conclusions. If total iron wear is taken as a direct measure of cylinder wear it might be possible, taking cylinder wear with SAE 20 oil as standard and 100%, to conclude that cylinder wear would be 90% with SAE 30, and 104% with SAE 10 and 75 neutral. Applying the Everett findings to the results of a 110,000-mile road test, the figures indicate that over the range in viscosity from 75 neutral to SAE 30 oil, the difference in cylinder wear per 110,000 miles due to viscosity differences would be approximately one-tenth of a thousandth of an inch.

"Under ordinary service conditions the rate of cylinder wear is evidently due largely to other factors than the viscosity of oil. This indicates that the difference in the rate of cylinder wear over the range of SAE 10 to SAE 30 is sufficiently small due to oil viscosity difference so that the choice of the SAE viscosity to use in an engine will depend upon other factors, such as oil consumption, the decreased engine friction due to lower viscosity oils, or the greater ease of starting in cold weather with low viscosity oils."

Mr. Beall said that under ordinary operating conditions, higher protection comes from higher viscosity oil, which provides a greater oil-film thickness. Diluted oil of higher viscosity appears to be more satisfactory than a less-diluted oil of lower viscosity.

Prof. Everett pointed out that the purpose of the tests was not to permit selecting of oils solely by viscosity, but rather to provide a better basis of judgment by increasing the knowledge of each property of oil. He explained that the temperature of an ill person is not necessarily an indication of the nature of the disease, but does contribute to knowledge of his condition; so finding the effects of viscosity contributes to the much-needed knowledge of the nature of the various properties of oil. Prof. Everett commented that the road test to which Mr. Mougey referred in his written discussion was a commercial operation.

TRANSPORTATION & MAINTENANCE SESSIONS

Chairmen

J. Y. Ray — **J. M. Crawford** — **Col. T. L. Preble** — **A. M. Wolf**

The war is directly responsible for the urgency of the varied problems discussed at the two sessions arranged exclusively by the Transportation and Maintenance Activity as well as in the one arranged jointly in cooperation with the Military Motor Vehicles Meetings Committee.

This later session developed major problems for direct management-Army cooperation on war equipment maintenance projects as well as new lights on engineering phases.

The absence of new vehicles to depend upon for increasing civilian transport demands focused the limelight on civilian vehicle maintenance more strongly than ever before – and, in addition, the acute shortage of mechanics has spotlighted the need for training large numbers of new repair men and foremen in the shortest possible time.

***Cooperation of Vehicle Manufacturers in Army Maintenance Program* – BRIG.-GEN. JAMES KIRK, Ordnance Department.**

This paper is printed in full beginning on p. 23 of this issue.

DISCUSSION

In opening the Gen. Kirk session, Mr. Crawford pointed out that most of the problems outlined in Gen. Kirk's paper were primarily industry problems, although many technical angles were involved. He extended a cordial invitation to representatives of the Automotive Council for War Production to participate in the discussion, since that group would be the natural source of action for the Army on industry problems.

Col. Preble noted that the job of organizing the efforts of traveling factory service men to eliminate duplication of effort and the giving out of conflicting data to the Army is a job for the Automotive Council for War Production. Col. Preble then announced that an SAE Ordnance Vehicle Maintenance Committee was in the process of organization to cope with the strictly technical problems with which the SAE is particularly qualified to deal.

George W. Romney, general manager of the Automotive Council for War Production, immediately offered the full facilities of the ACWP to Gen. Kirk, saying that the ACWP welcomed the approach made to these problems by both Gen. Kirk and Col. Preble. Mr. Romney stated that he and his associates stood ready to consult and help on any Army problems that fell within their sphere of usefulness. Mr. Romney felt that we all have a big obligation to the Private Jones referred to in Gen. Kirk's paper and that all of us were concerned with discharging this obligation to the best of our ability.

Lt.-Col. B. J. Lemon added that the rubber industry is cooperating with the Army on research and maintenance. Rubber industry representatives worked together on Army problems at the Louisiana maneuvers one and one-half years ago. Speaking for industry, William J. Davidson, vice-president of General Motors Corp., said that industry

had always worked with its customers and that it intends to continue to help the Army.

J. R. Glazebrook, technical adviser, Johns-Manville Corp., asked if there had been any standardization of replacement parts. Mr. Crawford voiced the opinion that the engineering department could not stop to redesign in the middle of a war.

Stephen Johnson, Jr., Bendix-Westinghouse Automotive Air Brake Co., welcomed criticism of industry and its products by the Army because that is the best method of arriving at the most efficient implements of war – and industry is just as eager to win the war as the Army.

Private Jones had another adherent in a representative sent to the session by Lt.-Gen. Lesley J. McNair for the express purpose of seeing how much consideration Private Jones was going to get – and who felt that Private Jones was being treated very well.

Men trained with factory manuals come to look upon these manuals as bibles, according to Brig.-Gen. S. G. Henry. As a result, their confidence is badly broken when they encounter a mistake or conflicting information. For this reason, Gen. Henry urged a check and double check of all maintenance material before it is incorporated into maintenance manuals.

Gen. Henry also urged manufacturers to check with one another to obtain uniformity in maintenance instructions. It was pointed out that a unit was listed for service every 1000 miles in one maintenance manual while the identical unit in another manual called for attention every 30,000 miles.

Recently the Army had to immobilize one type of vehicle because various representatives of one manufacturer were advising different quantities of lubricant in the crankcase and some trouble with this was encountered until the correct quantity was determined.

Industry was farsighted enough to train a few key men in maintenance, and for this Gen. Henry was duly thankful. They have helped the Army in its training program immensely.

Gen. Henry cited the instance of one Army unit going to bed one night, a gas propelled unit, and awaking in the morning to find itself with diesel equipment. An instruction team of five men and 6000 lb of instruction equipment was dispatched to the unit which stayed with the unit until the unit was capable of maintaining its new equipment.

One questioner said that manufacturers received different information on their own equipment from different sources in the Army and this caused confusion in the maintenance instructions. Gen. Kirk replied that this would probably always be, and that it was due to different conditions and different uses to which Army equipment is put.

Fred L. Faulkner, Armour & Co., put much of the trouble in the class of growing pains which were common among commercial fleets some years ago. Fleet operators, according to Mr. Faulkner, have been through this mill and would be glad to help the Army.

The Fuels and Lubricants Division of the Army has already simplified the problem of supply by reducing the number of types the Army shall carry, it was stated by Raymond Shaw, Chek-Chart Corp. Mr. Shaw felt that the oil industry should help out by clearly marking lubricant containers with accepted symbols.

Preventive Maintenance and Inspection Procedure – E. N. HATCH, American Brake Shoe and Foundry Co.

THE best preventive maintenance and inspection procedure is one designed to show *what* should be done, *when* it should be done, and *how* it can be done to obtain the maximum reliable service from each vehicle at the minimum cost, Mr. Hatch asserted in his report on the work of the SAE-ODT Committee No. 14, which has been working on this problem for several months with many of the leading maintenance men of this country.

"The practical application of a preventive maintenance and inspection procedure," Mr. Hatch said, "requires a simple, concise, yet flexible, system that will extend the life of the vehicle and save replacement parts and labor."

To simplify the recommended procedure, all important parts of the motor vehicle (car, truck, or bus) have been divided into groups and systems, and arranged alphabetically to provide a quick, practical source of reference.

To indicate *what* should be done, the committee established the six most common functions: A – adjustments, T – tests, O – oil, lubricate, or grease, L – light or visual check-up, H – heavy or physical inspection and repair, and R – replacement, rebuild, or recondition.

The required maintenance service has been divided into five types:

A. Service for daily requirements.
B. Service for lubrication and light inspections.
C. Service for heavy inspection, adjustments, and repairs.
D. Service for heavy repairs and replacements.
E. Service – most complete reconditioning.

Using a standard type of service, the mileage or time interval can be varied to fit the individual operating conditions and still maintain a standard maintenance service. The number of mechanical failures on the road is the best indication of how often the vehicle should be serviced.

The basic plan, as outlined by the committee, gives fundamentals of preventive maintenance showing *what* common work functions must be considered, and *when* they are to be applied in one or more of the standard maintenance service periods.

The detailed description of how to make the adjustments, tests, lubrications, light and heavy inspections, and repairs, has not been completed to date. The committee feels that the manufacturer of the equipment, working in conjunction with the maintenance men, is best qualified to explain in detail *how* to make adjustments on his equipment.

DISCUSSION

What matters these days is not the cost of the failure of truck parts but keeping failures from happening. Vehicles must be kept going regardless of cost. With these thoughts Chairman Ray started the discussion rolling. He said that the procedure outlined by Mr. Hatch is not so important for the large operator who already has a system that works for him, but for the small operator with only one to ten vehicles to take care of. On the other hand, such an extensive procedure may be hard for the small fellow to carry out, for he doesn't have at his command the equipment that the big operator has. Mr. Ray indicated that an important phase of the work was the education of these small outside shops in proper procedures.

The need for placing under control as many of the elements involved as possible was the point stressed by J. A. Harvey, Pittsburgh Motor Coach. "An orderly inspection and repair procedure of each unit of the vehicle based on the operating history should be developed," he said. This inspection should preferably be started on a short interval, Mr. Hatch stated, and extended as experience warrants so as to conserve parts. Mr. Harvey gave an example of lubricating and inspecting buses, or the "B" inspection, where the interval was extended from 1000 to 2500 miles. Check sheets should be used, and as each unit is inspected it should be checked off or shipped for repairs rather than having the inspector wait until the end of the shift to fill out the form.

The importance of keeping paper work to an absolute minimum was emphasized by Mr. Harvey as well as by F. L. Faulkner, Armour & Co., F. K. Glynn, American

Telephone & Telegraph Co., and G. Norman Gascoigne, National Refining Co.

H. L. Eberts, Small Electric Motors, (Canada) Ltd., cautioned against trying to determine failure only the day before on such parts as distributors, carburetors, fuel filters, fuel injectors, and brakes. These parts are too vital, failures on the road too serious, and it is too important that skilled work be done on them, to try to wait until the last minute. A further problem results from the lack of uniform operation in some units. On 27 makes of vehicles of his company there was no uniformity of generator speed; therefore a different figure had to be set for each type of generator. Mr. Eberts believed that specified mileage intervals should be used on these types of units, which figures may be gradually improved over a period of years.

Mr. Faulkner would like to see a supplemental report of a very simple nature based on daily, 1000-, 5000-, and 15,000-mile inspections. Since there is such an acute shortage of manpower, it is important that the mechanic's time be spent on repair work, with the paper work reduced to a minimum. He also mentioned that it is necessary to depend on the driver to make reports on his vehicle. If he is properly educated to listen for unusual noises and instructed to check safety features for himself – with further checks by the shop – he can do much to reduce both the amount of maintenance necessary and road failures.

M. C. Horine, Mack Manufacturing Corp., thought that standardized maintenance would work a benefit to the manufacturer.

The manpower shortage has become so acute with F. C. Patton, Los Angeles Motor Coach Co., that he is getting to the point where he doesn't ask if a man is experienced, merely if he is alive.

Hoy Stevens, Cleveland, Columbus and Cincinnati Highway, Inc., wants a standardized procedure consisting of simple shop tests, the results of which can be written down on a paper form by the inspector for review by the foreman. He believed that the tests had to be simple, as inspectors are going to have less and less experience as more men are lost by the shop. Tests are important, too, he said, because it is easier to train inspectors than it is to train mechanics.

M. E. Nuttila, Cities Service Co., said that any preventive maintenance program must be flexible, in addition to the other requirements. Flexibility can be obtained by the use of pilot test units in service and a test procedure in the shop. Instrumentation will be more used in the future, but Mr. Nuttila added: "Don't forget to test the instruments. They get out of order, too."

A. M. Wolf, T&M vice-president for 1943, concluded the session with the thought that you must still have mechanics who know what they are doing, for it is ever true that you can't put common sense on paper.

Training of Automotive Mechanics – FLOYD PATRAS, Southwestern Greyhound Lines, Inc. (Presented by J. W. Lord, the Atlantic Refining Co., in the absence of Mr. Patras.)

REPORTING for Committee No. 18, Chairman Patras submitted an outline of training for automotive mechanics, featuring 75 "job types" required to instruct mechanics to perform average automotive vehicle maintenance. The committee, one of 30 reporting through the SAE Maintenance Methods Coordinating Committee to the Office of Defense Transportation, is composed of 18 members, each an authority on training automotive mechanics. In the aggregate, these men are responsible for training mechanics and operators for companies owning and operating a total of more than 30,000 trucks and buses from coast to coast.

The author pointed out that old apprenticeship training systems are inadequate these days because:

1. The rapid pace of automotive development makes it impossible for the older craftsmen in automotive garages to keep up with the changes, and hence they are generally incapable of imparting this knowledge in any considerable degree to apprentices, and
2. New mechanics must be trained at a rapid rate to help keep vehicles rolling in spite of restrictions on new parts and new repair equipment.

In introducing the recommended practice of automotive mechanic training, the committee reported it is essential that the mechanic be taught to:

1. Diagnose troubles, and
2. Make necessary adjustments and repairs without supervision.

In general, the report outlined in some detail these phases of the problem: How to select trainees; plan for training; rudiments for preliminary training, and recommended training methods. This was followed by the recommended course of training, detailing the 75 "job types." Actual shop work is required with classroom instruction.

DISCUSSION

The comprehensive program suggested would fit long period training, but it cannot be carried out in a time short enough for present conditions, contested G. W. Laurie, the Atlantic Refining Co. He suggested three months as long enough for the training period. The program outlined could not be carried out in this time, but not all the subjects mentioned are necessary, for even many veteran mechanics don't have all this knowledge. Since most boys have some familiarity with cars, many basic parts of the course could be omitted for them which certainly would have to be included in a course designed to train women. He felt that the program as outlined would be more suitable for training supervisors than mechanics. He suggested, as a program, first putting the student in the tool room, then shifting him to the lubrication rack for a couple of weeks, and finally putting him with a trained mechanic from whom he would learn rapidly the use of tools and parts. He insisted that it is not necessary to put the student through a course that will give him all the theory of automotive engineering. This latter thought was echoed by T. C. Smith, American Telephone & Telegraph Co., R. A. Henderson, Detroit Board of Education, F. L. Hall, Bendix-Westinghouse Automotive Air Brake Co., and M. C. Horine, Mack Mfg. Corp.

That a real mechanic's training program is needed, not just a few more wall charts to be tucked away and never used, was the opinion of J. W. Lord, The Atlantic Refining Co. Mr. Lord was also worried about the background of those who are to instruct the students. Too often students are put with mechanics who, although they may have had many years of experience, still do not know the best methods. He questioned the use of slides as a means of instruction. It is too easy for the student not to pay attention while they are being shown. Some students take longer than others to absorb the information being imparted. Slides cannot be used for reference at a later time, either. He felt, on the contrary, that there is a great need for individual instruction.

The importance of having good teachers was also mentioned by Dean Fales, M.I.T. Good foremen are not necessarily good teachers, and they are even more scarce, he said.

The use of a course intended to give the student specialized training rather than a broad background was requested by R. E. Fielder, General Motors Truck & Coach. J. A. Harvey, Pittsburgh Motor Coach, believed that the apprentice should be placed where he can learn the most and be most useful in the shortest time. The necessity for

tests to eliminate the students who obviously won't be able to absorb the course – and simple arithmetic tests will weed out a large percentage – was mentioned by Fred Patton, Los Angeles Motor Coach Co.

The problem is really a simple one, if we would only recognize the simplicity and not try to make it complicated, Brig.-Gen. S. G. Henry, Armored Force School, stated, for Hitler won't wait for an extensive program to be carried out. He said that it is important to break down the job into component parts, demonstrate each job to the student with the proper tools, and then have him imitate the teacher a sufficient number of times until he learns the operation. The student must also be required, while still at school, to do the work in the field as well as in the clean and comfortable classroom. He must learn to work on vehicles that have been in actual operation, with bolts and parts that are rusted and covered with dirt, rather than just with a "school" vehicle that almost comes apart itself after a few classes have worked on it. He explained that 2250 teachers at Fort Knox were successfully applying these methods and were turning out 200 men a day.

K. B. Britton, Bendix Products Div., thought that maintenance could be cut down if drivers are taught to operate their vehicles in the best way – the way that stressed and wore the parts least.

AIRCRAFT-ENGINE SESSIONS

Chairmen

S. K. Hoffman — **A. L. Beall**

There was a wide range in the topics covered by the sessions. A very thorough review of carburetion brought on a discussion as to how well the carburetor is adapted to do its job, and whether or not anything could be gained by application of a little streamlining – both external and internal – to this important part of the engine. A paper on the integral powerplant induced a heated discussion about it. The program was rounded out by a paper on tool shop organization, a most thorough presentation of the methods of stress determination, and a review of some new engine materials.

Carburetion for the Aircraft Engine– F. J. WIEGAND, Wright Aeronautical Corp.

THE absolute importance of obtaining specific and complete information on the operation of aircraft engines in the airplane over the entire flying range, particularly in the case of the high-speed airplane, if we are to obtain the most effective airplane possible, was emphasized by Mr. Wiegand.

In the past, the problem of checking fuel-air ratios in flight was not solved in a very satisfactory manner, because other accessories of the engine that influenced the ratio might not be operating perfectly, thus causing unpredictable variations. The last five years of development in propeller governors, ignition systems, fuel systems, cowling, superchargers, and instruments, Mr. Wiegand reported, have brought them to function well enough to enable the carburetor engineer to obtain reasonably good data on operation of carburetors in flight.

Mr. Wiegand set up certain characteristics of aircraft engines that affect carburetion. These are:

1. Since the engine operates on air, the carburetor must meter the fuel in proportion to the weight of air burned, which has a direct relation to indicated horsepower output.

2. Engine air consumption, and therefore fuel consumption, bear no fixed relation to brake horsepower or brake specific fuel consumption.

3. Since the carburetor meters on the basis of airflow, there is no fixed relation between carburetor metering and brake specific fuel consumption.

The aircraft carburetor has certain functions, which can be summarized as follows: It should meter and mix fuel in a selected proportion to the weight of air consumed by the engine; provide fuel-air ratios for all flight operations including take-off, climb, and cruise that will be satisfactory for both cooling and long range with an almost infinite number of engine load conditions; incorporate an acceleration system that will allow the pilot to open and close the throttles at any rate, at any load, at any altitude, and at any frequency without backfiring, hesitation, or torching; meter satisfactorily with many types of fuel systems and air systems at any altitude. These metering requirements cannot be achieved in practice, and must be qualified and compromised in accordance with existing engineering knowledge. These strict metering requirements must be met in a carburetor that does not weigh more than 0.025 lb per bhp or occupy more than 1 cu ft of space.

If such severe conditions are to be met, it is obvious the highest skill is required, first, by the engineer in the development of the carburetor, and then by the manufacturing department in keeping to the close tolerances called for. Even when the best techniques of today are followed, it cannot be expected that the present carburetors can meter to closer limits than $\pm 5\%$ over the entire engine operating range.

Present methods of checking carburetion in flight do not necessarily determine the complete functional performance of the carburetor, since the measurements taken reflect, to a large extent, the engine efficiency as well as the efficiency of the personnel and equipment used in conducting the test.

"Considering the variables involved," Mr. Wiegand concluded, "the quality and functional performance of present carburetors are considered satisfactory from a practical operating standpoint, and with further cooperation of the aircraft, carburetor, and engine manufacturers, should continue to improve in a normal manner."

DISCUSSION

Chairman Hoffman started the discussion by reading the written comments of E. A. Ryder, Pratt & Whitney Aircraft, in which Mr. Ryder suggested that Mr. Wiegand's list of rules to be followed for avoiding experimental errors should include another item, namely: measure each important value in two ways. "It is not necessary to carry the principle of duplication into all our routine measurements," he said, "but any new set-up should be tested in this way for it is about the only way to *know* that our technique of measurement is adequate."

The importance of actual flight tests in the further improvement of the American carburetor, which is already better than anything our Allies or the Axis have, was brought out by F. C. Mock, Bendix Aviation Corp. "In the automobile work, it is common to test carburetors in road driving service about 18 months before car production starts," he said, adding that "in the aviation field we have been lucky to get flight tests, if at all, by the time production has been under way six months." Those very few occasions when the carburetor men have had a chance to follow a flight test to its finish have always brought out important basic knowledge. Mr. Mock noted that the situation is becoming better, thus giving the carburetor engineers an opportunity to deliver further improvements.

Even official Government procedures have been based on the assumption that the engine and its components can be developed for production by ground tests alone, Mr. Mock continued. "This often fails to be true," he said, "particularly with regard to effects of vibration, fuel boiling, and temperature extremes: the carburetor is responsive to all of these." He hoped that the Army and Navy would set up the proper equipment to run flight tests as a matter of routine. "This would accelerate our progress tremendously in itself, and pave the way for more rapid, more complete, and more practical development of all engine components," he concluded.

The carburetor situation is not as tied up as this paper implies, commented SAE Aircraft Vice-President John G. Lee United Aircraft Corp. He remarked that, to the airplane man, the carburetor seems to be the only part of the plane that violates all the rules of streamlining, internally and externally.

Answering Mr. Lee, Mr. Wiegand said that he certainly didn't consider the carburetor problem as solved; however, with the best air measuring systems known today, the tolerances he mentioned in the paper still hold true and there isn't much that can be done about it. He countered that it takes more than looks to make a carburetor.

A further reply was provided by Mr. Mock, who said, "It has been our experience that criticism of internal flow paths, based upon the study of external flow theory, is not always born out by actual fact. One of our demonstrations of carburetor airflow is to suspend a thread from a fine wire at the entrance to the high-velocity portion of the air passages, and just back of it a stopwatch. With airflow corresponding to rated power, a time exposure photograph will show the thread steady and clear cut, while the stopwatch hand will of course show a blur. Inasmuch as turbulence usually accompanies any appreciable loss of flow energy, our carburetor passage forms cannot be too bad."

J. F. Campbell, Holley Carburetor Co., emphasized the importance of saving even a small percentage of fuel in flight, pointing out that such savings are particularly important on distant war fronts, where a few gallons more in the tank may mean the difference between the plane being able to get back to its base and not being able to, thus falling into enemy hands or into the sea. He discussed some flight tests made with accurate fuel flow meters and airflow indicators. A check on the amount of fuel actually used by the plane during the test was obtained by measuring the amount of fuel in the tank before and after each flight. There were discrepancies up to 15% in the results between the various test pilots. To bring out the importance of making advancements, he said that a further improvement in carburetion of 2½% would up payload 8%.

Another member of the audience described briefly a new device for measuring airflow that has an adjustable orifice. He claimed that this instrument eliminates the difficulties of the air bottle system.

Aviation Power Plants – Dr. SANFORD A. MOSS, General Electric Co.

"THIS paper is about a thing that can't be done, and even if it could be done, isn't worthwhile – at least so some will say. Or perhaps some will say that the plan here discussed already is under way, so that this paper is superfluous. If so, this is all right by the author. But let's have a little argument anyway about the integral powerplant." It was thus that Dr. Moss introduced his paper on the new, and yet old, integral powerplant plan – new, because in this country at least, it hasn't been adopted and isn't widely known – old, because some experimental work was done on it as far back as 1921.

As outlined by Dr. Moss, the plan means that the powerplant would be built to form the front section of a nacelle – designed, assembled, and tested as a unit by groups specializing on this job. Other groups of aerodynamic specialists would prepare the plane up to the nacelle fire wall, and provide the studs to which the integral powerplant section would be attached.

Since ease of replacement is a major factor both in peace and in war, the advantages of the plan are obvious. "Rapidity of production so much needed in wartime is now being helped by manufacture of various components in parallel as independent groups, later assembled to give a complete apparatus. The integral powerplant helps this nicely," said Dr. Moss. He added, "The integral powerplant will enable improvements to be made with greater ease. A redesigned powerplant section can be used with an existing plane design or a redesigned plane with an existing powerplant."

So far, the English and the German engineers have taken the initiative in developing the plan, with us in America only talking about it. Dr. Moss expressed the hope that a committee of representatives from interested organizations might be appointed to study the situation and make definite proposals for the standardization of the junction of plane and powerplant at the fire wall.

DISCUSSION

The serious obstacles involved in carrying out the integral powerplant idea were emphasized in a written discussion by Alexander Kartveli, Republic Aviation Corp., which was read by Chairman Hoffman. Mr. Kartveli conceded, however, that such powerplants are feasible in the case of fairly simple installations, such as those involving unsupercharged or single-stage supercharged engines.

"It is extremely doubtful," Mr. Kartveli wrote, " that an integral installation involving a large and complicated powerplant could be made standard for all pursuit-type airplanes without making serious sacrifices in the performance or other qualities of the airplanes."

In applying the integral powerplant to a high-powered, low-wing or mid-wing pursuit plane, designed for maximum speed and very high critical altitude, it would be necessary to have a firewall area much larger than the engine, to take care of the large engine, supercharger, and intercooler that would be required. Thus the compactness of the integral powerplant would be offset by the large cross-sectional area of the fuselage which would be necessary. The result would be that this design undoubtedly would have a larger drag than one with optimum dimensions.

Balance also presents difficulties, according to Mr. Kartveli. The pilot should be located forward for good vision and the fuel must be near the center of gravity. To balance this weight, the wing would have to be moved so far forward that the wing would pass through the powerplant installation. Other problems, such as optimum locations for cooling air inlet and discharge openings, armament requirements, and variations in structural requirements for engine cowling, would make it difficult to use the same high-output powerplant for all types of airplanes using the same engine, without some compromise in the qualities of all of them.

In conclusion, Mr. Kartveli stated that before any serious attempt is made to develop the integral powerplant idea he believes it advisable to start with the simplest powerplants. If these prove to be of sufficient advantage to merit wide acceptance, the study could be extended to the more complicated types.

A. C. Staley, Chrysler Corp., presented the comments of C. A. Stamm, of the same company, who thought that the idea had many advantages and could easily be applied to large multi-engined airplanes. He felt that the use of liquid-cooled engines would be difficult to adapt, however, particularly because the present trend is to move the radiator away from the engine to some point in the fuselage or wing in order to decrease the cooling power losses.

John G. Lee, United Aircraft Corp., thought that it would be a good idea to decide first what is to be meant by the term "unit powerplant." If it is to accommodate various units – liquid cooled, single-row radial, double-row radial – a most difficult design job would be presented. He felt that the "overall" nostrum should not be applied in all cases.

The fact that putting the turbosupercharger so near the engine would have the effect of increasing the already too

high exhaust gas temperatures, was pointed out by Bob Winslow, Continental Aviation & Engineering Corp. He added that this would require that intercoolers be used more often.

Arthur Nutt, Wright Aeronautical Corp., thought that effort spent in trying to make powerplants interchangeable was largely misdirected. Too many variables and too much mathematical work are involved in such efforts. He suggested that it is better to spend one's time trying to simplify the various parts, and to design a more suitable powerplant for one installation, than to worry about making them interchangeable.

In support of the author's recommendations for group study of integral powerplants, J. E. Ellor, Rolls-Royce, Ltd., outlined British experience along this line.

"A number of years ago," Mr. Ellor said, "engine builders realized the many advantages to be gained if the airplane designers could be supplied with a proved integral powerplant. This entailed the promotion of an additional establishment with a group of powerplant experts, complete powerplant ground testing equipment, and numerous airplanes to obtain full-scale flight data.

"The results have been most beneficial in that the airplane designer is furnished with complete data on the powerplant and its installation, which will furnish maximum thrust for minimum drag and weight with the knowledge that the reliability of the combination has been proved. The benefit of the work is shown by the fact that three well-known multi-engine machines in Britain have similar integral powerplants developed by the engine builder up to the bulkhead; this of course in conjunction with the airplane builders."

Mr. Ellor told of the formation by the Society of British Aircraft Constructors, even before the war, of a committee with representatives from the industry to study the possibilities of the interchangeability of integral powerplants – both aircooled radial and inline liquid-cooled types. Their studies showed that by grouping the various engines into power classes, interchangeability was not only possible but practical, with surprisingly little concessions on cross-section of the bulkhead size. This investigation was made with particular reference to nacelles mounted on wings.

"It is of course conceded," Mr. Ellor continued, "that improved airplane design may warrant rearrangement of powerplant units particularly of single-engine and twin-engine combat types." However, he thought that these will always be the heavier multi-engined type of craft in which integral powerplants can be used to great advantage, and that Dr. Moss's proposals were worth consideration.

Use of a turbine type of engine, which can be made much smaller than conventional ones, was suggested by A. J. Page.

In replying to his critics, Dr. Moss insisted that he realized the integral powerplant was ruled out for the single-engine plane. He thought the problems encountered with the placing of the turbosupercharger near the engine could be solved without too much difficulty.

Tool Shop Organization and Methods – W. F. PIOCH, Ford Motor Co.

THE Tool and Die Building of the Ford Motor Co.'s Rouge Plant is a marvel of modern engineering planning, according to Mr. Pioch. The building is the largest of its kind under one roof, being designed in this manner to centralize all possible toolroom work. It is located on a feeder lane, running east and west through the plant, and is readily accessible to all the manufacturing buildings.

This tremendous building is of very modern design, even down to the landscaping, which might seem like a foolish expenditure, but actually helps to keep the building and its equipment cleaner.

Throughout the building are placed numerous electric hoists and cranes for easier handling and as a safety measure. The latest type of machinery has been installed, and work from small watch repair to mammoth rolls for the rolling mills can be accommodated.

The building is divided into three principal departments: die construction, small tools and fixtures, and machine construction and repair. Men in each of these departments specialize in their particular kind of work. In addition, there are four smaller departments on the main floor, coordinated with the three main departments: welding, heat treat, special gear cutting, and scale repair.

A pyrometer and time clock repair department is on the balcony. This is completely enclosed in glass.

The entire building is under the supervision of a superintendent and two assistants. Through the clearing house of this building all orders are received for scheduling work. From here, orders, blue prints, rough stock, and so forth, are dispatched to proper sources for completion.

Methods of Stress Determination in Engine Parts – CHARLES LIPSON, Chrysler Corp.

THE old methods of structural and machine design, based on large doses of empirical formulas reinforced by factors of safety, are rapidly becoming outmoded in the fields of airplane and automobile engineering, due to the increasing importance of weight saving requirements, and new methods, involving accurate stress measurements are being demanded, Mr. Lipson emphasized.

The author described four methods of experimental stress analysis that are used in the Chrysler laboratories, namely: photoelasticity, stress coat, extensometers, and electric strain gages. He also showed how they are applied in given engine problems involving evolution of a new design, determination of the cause of failure, and a comparison between various designs.

Photoelasticity is the science of measuring stresses in an elastic body by optical means. A polarized beam, upon entering a stressed transparent plastic model, will divide into components travelling in the two principal planes. Due to the difference in velocity of these two components, optical interference takes place and the fringe number becomes an index of acting stresses. In addition to the usual two-dimensional technique, methods of three-dimensional analysis are described.

Stresscoat is a brittle lacquer that fractures at low values of tension strain. Because of this property it may be used as a coating on loaded parts to indicate the location, direction, and magnitude of the strain. Compression strains may also be measured by allowing the coating to come to a neutral condition while the part is loaded.

Fundamentally, an extensometer is a device for accurately measuring changes in distance between two fixed points on a part subjected to an external load. The distance between the two points previous to the load application is known as the gage length. For stress analysis work only short gage extensometers are of practical importance. Such extensometers require an elaborate provision for accurate magnification of the actual strain. Mr. Lipson described the mechanical, optical, and electrical means used in the Chrysler laboratories.

In electric strain gages, a variation in average strain is accompanied by a proportional change in their electrical characteristics. This is then measured by suitable electrical instruments. The types of gages described by Mr. Lipson were: electromagnetic, piezoelectric, carbon resistance, and wire resistance.

In the utilization of the four methods of experimental stress analysis described, there are two principal means of procedure: static tests, using simulated service loading, and dynamic tests, under actual service conditions.

Static load testing, Mr. Lipson said, is usually the most convenient and generally favored because the problem of instrumentation is greatly simplified. The penalty for this simplification lies in the fact that the investigation is often conducted on the basis of loads that may or may not correspond to operating conditions. Dynamic load testing demands more complex instrumentation and so far it is less thoroughly developed. A comprehensive stress analysis investigation requires both phases of testing: dynamic tests should establish the mode and magnitude of operating loads while static measurements will determine the corresponding stresses. Refinements on instrumentation and technique are necessary to promote greater accuracy and speed but this particular phase of experimental stress analysis is developing in a satisfactory manner.

DISCUSSION

Chairman Beall read the comments of Dr. A. V. de Forest, M.I.T., who was interested in knowing if Mr. Lip-

son thought it possible to obtain 2% gage factor accuracy in one-eighth inch gage length. Mr. Lipson said that 2% accuracy was obtainable.

Dr. de Forest also mentioned his efforts to find a substitute for the multi-element cathode-ray tube recording dynamic loads in resistance wire gages. He said that he has started to photograph the screens of a number of single-element tubes placed close together. Four such tubes can be conveniently photographed at once on a 35 mm film with a drum camera. He has used duPont 208 for this purpose without any preamplifiers, when dealing with strains of the order of 20,000 psi.

E. T. Vincent, University of Michigan, was interested in knowing whether the stress concentration factor used by Mr. Lipson was figured in the usual manner. He wondered how closely we could work up to the ideal limit as shown in the Goodman diagrams illustrated in the paper.

Mr. Lipson's answer to Prof. Vincent's first question was that the average stress was measured by photoelasticity methods. In discussing the other question, he said that the values must be compared with results of endurance limit tests, in which the accuracy varies from about 5 to 15%; and that existing limits will be varied in practice because of imperfections and scratches in manufacturing.

New Materials for Aircraft Engines **– M. H. YOUNG and H. H. HANINK, Wright Aeronautical Corp. (Presented by Mr. Young.)**

"CONSERVE strategic materials!" has been the cry dinned into the ears of the designer of wartime products; consequently, the report on new materials for aircraft engines presented by Mr. Young was particularly timely. "The tremendous demands of war production," he said, "have now revealed our resource shortages, and in our efforts to build war and transport machines, it has become necessary to take conservation measures with some elements in particular and with all materials in general."

Mr. Young paid particular attention to new developments in the use of steels, plastics, synthetic rubber, and silver.

Aircraft engines, in common with other wartime products using alloy steels, will soon have an almost completely new set of alloy steel compositions for the majority of working parts. Mr. Young explained that these steels have been selected by the SAE Aircraft Materials and Processes Coordinating Subdivision from the well-known National Emergency series. This subdivision has been designated to make our strategic alloying elements: nickel, chromium, molybdenum, vanadium, and tungsten, stretch to cover our rapidly increasing alloy steel production without sacrificing necessary physical properties. Those NE compositions selected have been incorporated in Aircraft Material Specifications and are now designated as AMS alternates.

Mr. Young believes that in all respects the alternate AMS steels which he discussed will be equal to, and in some cases better than, the steels now used in aircraft engines both from the engineering and production standpoints. In addition, the steel compositions required will be fewer in number, which will allow a welcome "house cleaning" of carry-over and unnecessary compositions.

The use of plastics in engine construction appears to be limited because of temperature and stress conditions encountered in a powerplant where the highest output is demanded from the least weight. One of the examples mentioned by Mr. Young was the very successful use of pliofilm as a covering in which the engines are being hermetically sealed before being placed in the packing box for shipment to distant lands.

The development of various types of synthetic rubbers has brought their increased use in the powerplant, since it is possible by a variety of blends to fit each requirement of heat, oil, and fuel resistance.

Silver is now in satisfactory use as a bearing material, exhibiting higher fatigue strength, better heat conductivity, and greater capacity to withstand higher loads. Amazingly enough, these new bearings are no more expensive than the old ones, in spite of the high cost of silver.

DISCUSSION

F. F. Kishline, Nash-Kelvinator Corp., wanted to know if oxidizing surface treatments were being used in place of paints. Mr. Hanink said that the process had not been investigated or used by them, although he thought that it was probably the answer to some of the problems that have come up.

A. T. Gregory, Fairchild Engine & Airplane Corp., asked if zinc plate was likely to be used in place of cadmium plating. The authors said that they didn't anticipate there would be any cadmium shortage to make it necessary.

In answer to another question on the bonding difficulties encountered in the spraying of aluminum on steel cylinders, Mr. Hanink said the results of salt spray tests indicated that there weren't any great difficulties involved, although the results are variable.

C. F. Bachle, Continental Aviation & Engrg. Corp., was interested in hearing a comparison of the silver versus the phosphate treatment. The authors said that the phosphate bath treatment can be used only where fatigue is not a factor, as this property is lowered by the treatment. They thought the silver method was probably a little more satisfactory, although they did not believe it was possible to make a really fair comparison.

AIRCRAFT SESSIONS

Chairmen

E. L. Allen — **John G. Lee** — **D. C. Hunt**

New developments in welding, accessory power, and cabin supercharging gave these sessions variety, while papers on structural testing and the determination of fuselage moments provided the heavier part of the program.

One of these sessions, dealing with conversion of a body plant to aircraft production and application of flash welding to aircraft manufacture was arranged with the cooperation of the Passenger Car Body Activity Committee under the chairmanship of 1942 Vice-President E. L. Allen.

Accessory Power for Aircraft **– LT.-COL. T. B. HOLLIDAY, U. S. Army Air Corps, Wright Field.**

LET'S try to eliminate some of the complicated gear systems that are now being mounted on the rear of the engine to take care of accessories, by replacing them with just one electrical generator, was the proposal of Col. Holliday.

Accessory items were defined by Col. Holliday as that equipment not essential to flight. They are the items added to make the airplane easier to handle and safer to operate.

One simple and efficient way of obtaining the power to drive the accessories is by direct mechanical takeoff from the engine. Use of this method is restricted because of space limitations in the rear of the engine where the unit must be located.

The next method considered by the Colonel was the use of hydraulic power. Although it has a lighter fixed weight, as compared with electrical units, there are disadvantages such as high loss in efficiency in cold weather. A pneumatic system – also possible – is not satisfactory because of a definite control lag.

The final system discussed by Col. Holliday, the one he is particularly concerned with, was the electrical one. Its one chief disadvantage, that of excessive weight, is being rapidly overcome, making it seem as if use of electrical power is definitely the coming thing. Present generators weigh about one-eleventh as much as their predecessors of only a few years ago and obviously take up much less space.

The electric motor, since it can operate at a constant high speed, unlike the generator, which depends on the speed of the engine, can be made even more compact and efficient, and these properties improve with increasing horsepower.

In the matter of transmission, the electrical is far more efficient than the hydraulic system – and this advantage becomes even more apparent as the length of the transmission lines increases. Electric wires are also quite invulnerable.

Voltage and its hydraulic counterpart – pressure – must also be considered. A standard of 24v is now being used, a figure that can be increased almost without limit, whereas hydraulic pressures already seem to be approaching their upper limits.

In short, if the present weight and space taken up by the hydraulic pump, the pneumatic pump, and the generator were at the disposal of Col. Holliday, he could provide in its place a generator unit to accomplish the same functions at higher efficiency with less weight and with a lot simpler mechanism.

DISCUSSION

A. L. Beall, Wright Aeronautical Corp., asked how much overhang must be allowed for the generator. The Colonel suggested that 15 in. would be adequate. One member wondered if the generator might be mounted elsewhere than on the rear of the engine. Col. Holliday said that mounting it on the engine saved weight.

Peter Altman, Vultee Airplane Inc., was interested in the relative advantages of ac and dc. The answer was that ac is simpler, lighter, more efficient, and higher voltages are possible.

In answer to questions by H. M. Martin, General Electric Co., Col. Holliday said that a small auxiliary engine would be necessary to take care of the accessories when the main engines stopped, and that a generator should be provided for each engine, not just for one engine of a multi-engine ship. Another questioner wanted to know if ac was likely to replace dc completely on big ships. The Colonel said that they probably would always have to provide some dc.

A suggestion that the hydraulic system should be used for other purposes, since it has to be provided to operate the brakes was answered by Col. Holliday who said that the generator had to be there anyway, and the advantages are still with the generator, because the transmission lines for the electrical system are so much lighter than the hydraulic lines.

R. W. Brown, Firestone Tire & Rubber Co., wanted to know why electrical lines are invulnerable. The explanation was, that electrical wiring, since it hangs loosely, has a tendency to swing away when hit, so that it can be nicked without being broken.

Cabin Supercharging in Scheduled Airline Operation **– R. L. ELLINGER, Transcontinental & Western Air, Inc. (Presented by R. A. Walker, Transcontinental & Western Air, Inc., in the absence of Mr. Ellinger.)**

SUCCESS in supercharging airplane cabins for high-altitude flying, according to the author, came only by solving hundreds of small problems in areas beyond the ken of aeronautical engineering

Economic advantages of high-altitude operation have been proved beyond dispute, transport flight data show. But before such flights could be undertaken the engineering work had showed that adequate sealing could be accomplished, although not without a great deal of experimental work. Fortunately or unfortunately, the demand for developments required the use of actual ships as flying test laboratories instead of the use of simulated conditions in test chambers.

Sealing, according to the author, is the crux of supercharging cabins for the comfort of the crew and passengers. Low barometer and extremely low temperatures make oxygen supply only one of the problems to be solved.

Control of pressures at points where controls and other elements pass through the cabin out to other parts of the fuselage required designing seals of many types. Cable controls, plumbing, electrical lines, instrument vacuum systems, and even wash basin flow plumbing required a wide range of handling ranging from simple rubber and neoprene seals to special connector blocks, pressure reducing valves, and spring-loaded drain valves and inboard waste water tanks.

Each of these devices required a vast amount of exhaustive tests in planes, but the cabin supercharger unit itself still remains an enigma – despite the vast amount of engineering experience with high-speed blowers.

The system described by Mr. Ellinger is provided with two engine-driven superchargers, which bring fresh air in from the leading edges of the wings. An alternate system brings in air caught by scoops located on the top of the fuselage. Each of the superchargers has a control unit located inside the cabin.

Adequate cooling of the air within the cabin during the summer months, when the sun rays, unobstructed by clouds in high altitudes beat down on the airplane, and sufficient heating when the temperatures are low, are problems requiring more development. The wide variation of temperatures at any given high altitude requires, in effect, a dual system of temperature control and demands a careful control of humidity. To manufacture air required by humans under these conditions, and with as little weight as possible, is the problem discussed by the author. He suggests the need of ten-year-old thinking combined with the best engineering mentality to solve the problems ahead. Yet he recounts remarkable achievement to date, considering the pioneering aspects of supercharging airplane cabins.

DISCUSSION

H. W. Martin, General Electric Co., asked how much horsepower was required by a cabin supercharger. Mr. Walker answered that they used 25 hp.

O. E. Kirchner, American Airlines, Inc., related an experience of having the water blown up into his face, after he had turned it on in the washroom. At the end of the flight, he noticed a ball of ice in the end of the drain line. He said it was all right to have the water drain out during the summer, but in winter the line must be plugged and the drain water stored in the plane.

The Determination of Fuselage Moments **– C. E. PAPPAS, Republic Aviation Corp.**

"THE purpose of this paper," declared Mr. Pappas, "is to present theoretical coefficients of additional apparent mass for an ellipsoid of three unequal axes and to indicate the change in the theoretical coefficients when boundary layer, interference, and turbulence effects are considered. In order to determine the effect of a viscous, incompressible fluid on the additional apparent mass coefficients, wind tunnel tests on circular fuselages alone and in combination with a wing were used to determine the extent of the variation in the theoretical coefficients."

Mr. Pappas explained that from the figures presented in his paper pitching and yawing moments can be readily determined for circular fuselages alone and in addition the changes in fuselage moments resulting from the interference effects of a wing can be found.

So that the actual variation of the moment of a body moving in a viscous fluid in terms of the mass coefficients would be better understood, Mr. Pappas started out by developing the theory associated with the concept of additional apparent mass. He then applied the concept in determining the fuselage moments for a body of revolution and also for an elliptical fuselage.

Although the fuselages discussed had rounded noses, as are used in liquid-cooled engine installations, surprisingly enough these same fuselage moments apply equally well to radial-engine installations. Apparently the explanation for this is that the radial-engine installation behaves like a flat plate in that the air ahead of the engine piles up to such an extent that an equivalent rounded-nose body results, the air particles moving along a streamline which hypothetically extends the blunt radial-engine fuselage body to a rounded-nose shape.

DISCUSSION

Chairman Lee asked if the formulas derived in the paper were to be used to indicate trends. Mr. Pappas said that was their purpose. Mr. Lee then asked if, from this work, it could be deduced that the low-wing plane would be more stable than the mid-wing ship, and that pursuit planes, being small ships, would not have as much trouble with instability as large ships, because the latter would have less wing interference. Mr. Pappas said this was correct.

Aircraft Structural Testing **– B. L. SPRINGER, Civil Aeronautics Administration.**

PAYLOAD increases will come from using every bit of overstrength in the aircraft structure, the author believes. However, he said, strength testing appears to be the only direct and practicable manner of measuring these structures.

Importance of the test program itself was emphasized, and such

projects will require jigs and loading devices of unprecedented size to meet the problems of larger aircraft. For the huge airplanes of tomorrow, the structures may be so large as to make it more practicable to rely on section and model tests, he predicted.

Despite the complicated and costly nature of this type of testing, the expense and trouble can be repaid many times over during the life of a fleet of airplanes if only a small increase in payload results.

His paper presented a general view of some of the problems of structural testing of aircraft components, discussed flight test demonstrations, and static tests used in ground testing.

The latter were explained in considerable detail, describing the various methods and devices used by aircraft manufacturers today. Methods for applying loads, and details of gages used in this work leave considerable to be done, the author said. He suggested the development of both mechanical and electrical stress computers to permit more extensive use of rosette gage measurements, for example.

Structural testing is an important part of the development of any modern airplane, he concluded, if proposed craft are to reach their maximum load-carrying abilities.

DISCUSSION

In answer to a question, Mr. Springer said that there was a difference of opinion as to how the airplane should be supported in vibration testing. He didn't think the method of support had much effect on the location of the nodal lines, only on their amplitude. He said that so far no flight tests had been run to check the laboratory results on vibration.

Another questioner wondered of what use proof tests are, since the structure is not tested to destruction. Mr. Springer said that these tests give a general indication of what the structure will stand, even though there is no complete failure. He also mentioned that in actual flight, planes are able to take dynamic overloads way above these values. Mr. Lee told of ships that have come down after stiff tests with wings bent back but with no failure.

A Body Plant Goes to War – L. B. RIVARD, Lincoln Division, Ford Motor Co.

DESCRIBED by the author as "barnyard" engineering, the retooling of the Lincoln body plant to turn out jeeps for the Army, while still producing Lincolns on the same final assembly line, proved the vigor and ingenuity of American automotive production engineers.

Notified just before Pearl Harbor that the bodies must be built, assembled and painted, with deliveries to begin in January, management decided to use one of the three main conveyor lines for this job. The shop superintendent and several of his assistants visited another plant where jeeps were being produced, while the remaining engineers began to prepare for the shift.

Unfortunately, the earlier producer had built his production so rapidly that drawings had been dispensed with. Each fixture was photographed separately, and platforms and constructions were carefully measured. These were later noted upon the photographs which then served as drawings.

All available channel, angle, and plate steel was used in welding up the constructions, and even stock racks were cut up to provide construction material in order to save time. Panels were first made by hand, and some were supplied by the other manufacturer.

The labor problem was largely solved by the tapering off of passenger car production, and workers were given courses in making the new vehicle.

In order to compensate for the elimination of the main conveyor line, Zephyr bodies were shunted by trucks to the lower end of the conveyor line that had been cut, and the first jeep bodies and the Zephyr bodies were going through the paint oven on the same line.

The first shipment of jeep bodies was made six weeks from the date of the original notice, and by the end of January several hundred had been shipped and installed on chassis at the Rouge Plant. Many thousands of these bodies have been built during the past year, and the company is now building another Army vehicle of an entirely different design and size in parallel on assembly lines that had been turning out Lincoln and Zephyr bodies.

DISCUSSION

In answer to a question by L. L. Williams, International Flexible Tube Co., concerning the term "barnyard" engineering used by the author to describe the type of engineering they had used in setting up their fixtures, Mr. Rivard said that he meant the engineering often resorted to when the engineers are in a jam for time. The work doesn't go through the regular channels of layout, detailing, and the rest of the normal routine processes.

Production Applications of Flash Welding – ROBERT MILMOE, Lockheed Aircraft Corp. (Presented by E. M. Davis, Lockheed Aircraft Corp., in the absence of Mr. Milmoe.)

FLASH welding, Mr. Milmoe said, is a type of butt weld in which the two parts to be joined are connected to the secondary terminals of a low-voltage high-current transformer, are then brought into close proximity, and the voltage applied. This results in a flashing between the surfaces, heating them to the melting point. The flashing is continued for a predetermined period, the parts being moved together as the material burns away. At the end of the flashing period, the parts are forced together rapidly and the current is turned off, giving a welded structure of a forged nature.

While extensively used by the automobile industry, this process has not found its way into aircraft construction in the past, because the problems here are somewhat different, and in many cases more exacting.

Mr. Milmoe listed the advantages of the flashwelded joint over the fusion welded joint as including better physical characteristics, (100% joint strength), lower weights, cheaper and faster production, no warping as a result of welding, and less operator skill required. He said that SAE 4130 tubing joints welded in the normalized condition with no further heat treatment, exhibit physical characteristics equal to those of the parent material, when tested in static tension.

Most applications have been on tubular and solid round parts, although the process has been used on other types of sections. Parts include the common end-fitting to tube joint, in which the fitting may be a forging or may be machined from bar stock or another piece of tube.

The major points to be considered, said Mr. Milmoe, in designing aircraft parts for flash welding, are:

1. Mating surfaces of parts must be of the same shape and approximately the same cross-sectional area.
2. This cross-sectional area must be constant for a sufficient distance back from the joining surfaces to allow all burn-off to take place in such constant-area section.
3. Best design is for the welding faces to be normal to the centerline of the parts, so that the line of travel is parallel to this centerline.

While it is preferable to design new parts especially for the flash-welding process, the author pointed out that it has been found feasible to convert parts which are being arc or gas welded.

DISCUSSION

Replying to a question from the audience, Mr. Davis said the technique for flash welding copper and aluminum was developed by trial and error, with a different technique being worked out for each type of application. He added that these data are being cataloged for designers.

Max Sklovsky, Deere & Co., wanted to know if Lockheed had had any experience with flash welding sheet metal. Mr. Davis said they had not.

A question as to the relationship between the hardness of the welded and the unwelded part was answered by another member of the audience who said that the welded part is only a few points higher in hardness, and that there is very little crystallization.

DIESEL-ENGINE SESSIONS

Chairmen

A. J. Blackwood — **G. C. Wilson**

Stubborn diesel cold-starting problems yielded ground in this symposium to an attack from four sides: engine de-

sign, fuels and lubricants, accessory equipment, and practical military experience.

Deep interest in the latest results disclosed in this concerted assault held a packed audience until the session adjourned – an hour over the scheduled time for closing.

Superchargers came in for the undivided attention of another session.

The Effect of Injection Pumps on Cold Starting – MAX M. ROENSCH, Chrysler Corp.

"THERE is no satisfactory substitute for the application of heat prior to cranking; without a good heater, reliable starting at temperatures below 10 F is impossible on diesel engine for trucks of the type studied," Mr. Roensch contended. He explained that this conclusion was indicated in a cold-room investigation of some of the variables affecting the starting characteristics of a Dodge diesel engine, energy-cell – Lanova type, 3.75x5-in. bore and stroke, 331 cu in. displacement. A24-v starting system is used, he said, which includes sequence starting switch and solenoids for 6-v pinion engagement and 24-v cranking used in conjunction with an electric intake heater rated at 4350 w at 24 v.

His paper covered the results of a series of cold-room tests to determine the effect of the following factors on cold starting:

1. The quantity of fuel injected at cranking speed.
2. Two types of injection pumps.

In conclusion, Mr. Roensch summarized the results as follows:

1. For optimum starting, particularly at low cranking speeds, 75% to 85% more fuel is required than that delivered by the pump for maximum power, thus indicating the desirability of having some means of increasing fuel delivery for starting purposes.

2. Fuel pumps must have good distribution, even at low cranking speeds, for unless each cylinder will contribute its best power under these conditions, cranking speeds will not increase as rapidly as they should and therefore a longer starting time results.

Cranking Power and Torque Requirements at Sub-Zero Temperatures – H. L. KNUDSEN, Cummins Engine Co.

THE inescapable conclusion of Mr. Knudsen is, that an immersion heater is required for the starting of diesel engines at sub-zero temperatures. "With this method," he said, "the danger of scoring and scuffing pistons and cylinders during the cranking period due to improper oil films is removed. The engine can be started with the lubricating oil most suitable for it at operating temperature. Cranking power requirements are no greater than in the summertime, so that batteries need not be excessively large for winter starting – even the batteries might be kept up to temperature by an immersion heater, and hence a further reduction in weight and capacity would be possible."

Mr. Knudsen attempted to clarify the problem of sub-zero starting:

1. The fuel oil must be able to flow freely at starting temperature.

2. Lubricating oil must be available that permits cranking at about 100 rpm at the desired starting temperature with reasonable starting power requirements.

3. Starting power requirements must be such that they may be satisfied by batteries of reasonable size and weight.

4. Engine characteristics must be such that ignition temperatures for the fuel available will be reached within the combustion chamber when cranking at minimum starting rpm for the engine in question.

Tests were made to determine the starting power requirements at various temperatures with different grades of lubricating oils. These tests indicated that cranking power can be reduced by diluting the lubricating oil with kerosene or similar agents, but such a solution would be unsatisfactory. If a non-evaporating dilutent were added, it would have an extremely bad effect on the lubrication at operating temperatures; and if a dilutent that would evaporate were added, it would have to be added and mixed while the engine was hot and before each attempt to start.

Contrast with this the sure and snappy starting obtainable at very little inconvenience by using an immersion heater. In fact this latter solution solves all the problems set forth above except that of the fuel. Fuels that ow freely at –40 F, however, have been developed, so that this problem is now non-existent.

The Effect of Diluents on the Flow Properties of Crankcase Lubricants – J. C. GENIESSE, Atlantic Refining Co.

APPROXIMATELY 20% diluent is necessary to get satisfactory flow of SAE 10 and 30 heavy-duty grades of lubricating oils at —40 F. Kerosene and diesel fuels are much less effective as pour-point depressants than gasolines. These are the conclusions reported by Dr. Geniesse, chairman of the working group of the Cooperative Lubricants Research Committee of the Cooperative Research Council, requested to obtain these data.

Tests were undertaken at the request of the Ordnance Department of the U. S. Army. The purposes of the experiments were (1) to provide sufficient information so that the U. S. Army specification 2-104A could be revised to insure the procurement of oils satisfactory for low-temperature operation and (2) to obtain the effect of the amount of various diluents on the flow characteristics of these oils at low temperatures.

Ten commercial brands of oils meeting the specification 2-104A of both SAE 10 and 30 were tested. Average pour points with the various gasolines for concentrations of 0, 10, 20, and 30% by volume, as well as fluidity and pumpability of the oils, containing 20% gasoline, were obtained.

Several viscosity determinations were also made at 32 F and 100 F on oils containing 20% by volume of U. S. Army gasoline meeting specification 2-103.

Cold Starting Tests on Diesel Engines – H. R. PORTER, Standard Oil Co. of California.

INVESTIGATIONS on cold starting characteristics, reported by the author, were based upon tests to evaluate the relative importance of pertinent diesel engine variables, the relative effect of fuel properties, and to compare laboratory and service results. Tests disclosed:

1. Required cranking time is decreased with increased cranking speed, increase in surrounding temperature, and decrease in altitude.

2. The starting performance of undoped fuels is predictable by the delay cetane number. Increase of cetane number results in greater ease of starting. With doped fuels, however, the delay cetane number may or may not predict service starting performance.

3. It was indicated by tests on one make of engine that laboratory results may be used to predict service starting performance.

4. Various substances are effective as starting dopes, but the report indicated that an auxiliary applicator should be used, and warned that effect of such materials on maintenance should be predetermined.

The author outlined in detail the test equipment used, the test procedure, and the results.

Among the additives used were chlorine, hydrogen sulfide, amyl nitrate, ethyl disulfide, and chloropicrin. These ranged in amounts from 20 to 35 ml at ambient temperatures of 20 F.

Fuel Properties Influencing Starting Characteristics of Diesel Engines – F. C. BURK, Atlantic Refining Co.

REPORTING for the Full Scale Engine Group, Automotive Diesel Fuel Division, Cooperative Fuel Research Committee of the CRC, the author emphasized that additional work on other makes of engines than the one used should be completed before drawing the conclusion that cetane number is the only fuel characteristic which influences the ease of starting.

The engine, a 6-cyl, 4-cycle Lanova-type combustion chamber diesel, was mounted in a low temperature room where an auxiliary cooling system was used to accelerate chilling between the starting tests. The progress report was on results obtained on ignition quality under low temperature starting conditions. The whole project embraces four other phases of the problem, namely: Engine Deposits; Odor and Lachrymation; Power Output; Fuel Consumption, and Exhaust Cleanliness; and Engine Smoothness.

The author pointed out that contributing factors to ease of cold starting include preheaters, glow plugs, and other mechanical and electrical aids.

Storage Battery Performance at Low Temperatures – JOHN H. LITTLE and ROBERT A. DAILY, General Motors Corp. (Presented by Mr. Daily.)

PLENTY of heat is the best solution to the problems encountered in using storage batteries at low temperatures, Mr. Little said.

Freezing can also be prevented by keeping the battery fully charged. A fully charged battery, which has a specific gravity of 1.300, freezes at (–25 F) but if the specific gravity is allowed to drop to 1.220, the freezing point rises to –30 F – a temperature not uncommon in some regions.

Starting at low temperatures is difficult for two reasons. A cold engine requires higher torque to start it, and the colder the battery the less the amount of current that can be drawn from it.

A partial answer is to use a battery of higher voltage. An engine requires only one-fourth the amount of current to start it at a certain temperature when a 24-v battery is used than if the battery were only six v.

After an engine has been started, it is necessary to put back the energy taken out plus a little more because battery charging is not 100% efficient. This cannot be done at low temperatures. For efficient charging, the battery temperature should be at least 40 F.

For batteries that are used fairly frequently, it is helpful to keep them in well-insulated boxes, or in boxes that have had a piping system rigged up so that warm water can be circulated through the boxes. Another solution, satisfactory for batteries having rubber cases but not for those having composition cases, is to use a suitable heater. If a battery has been parked for days, even a well-insulated box is not enough, so that some sort of heater must be used. One type of heater in successful use is the Coleman No. 520 gasoline burner, which supplies 5000 Btu per hr. About 45 min should be allowed to heat the battery with this burner, before it can be used for starting.

The Importance of Accessory Equipment in Cold Starting of Diesel Engines **– W. J. PELIZZONI, International Plainfield Motor Co.**

A NUMBER of methods for supplying heat to the incoming charge of air sufficient to obtain combustion under sub-zero temperatures, were described by Mr. Pelizzoni. This extra heat, he explained, must be supplied because under initial cranking conditions, the heat of compression does not provide a temperature sufficiently high for self-ignition of the fuel.

Mr. Pelizzoni divided the methods of heating the incoming air into two general types: preheaters, which are used with the engine still motionless, and cranking heaters, which have the heat applied while the engine is being cranked. The necessary heat may be obtained either electrically or by the combustion of some of the fuel.

One form of heating by electrical means is to use resistance coils located in the inlet manifold, the current being supplied by the starting batteries. These may be preheaters or combinations of preheaters and cranking heaters, but cranking heaters alone are never used. When the preheater obtains its current from the batteries, there is the obvious disadvantage that the amount of current left in the battery for starting the engine is considerably reduced. Such types of heating are often satisfactory because of their simplicity and low maintenance requirements.

Electrical heating may also be accomplished by immersion heaters located in the cylinder-block coolant. This type of preheater has the current supplied by an external source. These heaters are ideal from the standpoint of simplicity and maintenance requirements, but they can be used only where 110-v current is available, because of the high output and the length of heating time required for results.

In cases where the installation and type of engine require an extremely rapid and high-capacity air heating arrangement, it becomes necessary to depart from the electrical method and to adopt some other device that will produce the necessary air temperatures without overtaxing the cranking equipment. One suitable and fairly popular method is to burn fuel oil directly in either the intake manifold or air box of the engine. This may be either a preheater or a cranking heater.

The last method described by Mr. Pelizzoni consists in burning the fuel oil in a separate stove inter-connected with the cylinder-block coolant. This is a preheater and bears a close relationship to the electrical immersion heater.

All these methods of applying additional heat seem to provide the necessary boost in temperature to relieve the cranking system of a large portion of the demand that would otherwise be required, Mr. Pelizzoni stated. He concluded with the thought that since all the systems have their limitations, no single arrangement would be sufficient to meet all requirements at sub-zero temperatures; therefore it might be necessary to incorporate either a combination of these units or a combination of one accessory with some special fuel additive.

Special Cold Starting Fuels for Diesel Engines **– C. H. CLOUD and L. M. FERENCZI, Esso Laboratories, Standard Oil Development Co. (Presented by Dr. Cloud.)**

"ON the basis of the results of our investigation," Dr. Cloud summarized at the conclusion of his presentation, "the diesel engine is no more difficult to start at low temperatures than is the gasoline engine. In addition, the use of the special cold-starting fuels described offers an opportunity for the conversion of units in the field where large batteries and auxiliary heating equipment are not available."

Presenting supporting data, Dr. Cloud pointed out that satisfactory starting of diesels at sub-zero temperatures cannot be obtained with conventional hydrocarbon fuels even though their cetane numbers may be unusually high.

Among Dr. Cloud's conclusions are:

1. Materials blended into normal diesel fuels in optimum concentration to improve cetane number and cold-starting will give a limited reduction in minimum starting temperature.

2. Starting agents introduced into the air stream of diesel engines (not including crankcase scavenge) will allow starting at sub-zero temperatures without additional starting aids, provided that the crankcase lubricant and cranking facilities give sufficient cranking speed.

THROUGH the courtesy of the Navy Bureau of Aeronautics and SAE member Com. James D. Mooney, four moving picture films on metal fabrication for aircraft were shown Jan. 15, the last session of the Annual Meeting.

Lt.-Com. L. K. Marshall, USNR, introduced the pictures, which were produced by the Walt Disney Studios for the Navy. W. E. Garrity of the Disney organization, who received an award for the sound effects he produced for the feature "Fantasia," discussed some of the technical phases of making the films.

Pictures shown were Forming Methods, Bending and Curving, Blanking and Punching, and Aircraft Riveting.

David Beecroft, treasurer of SAE, was chairman of the session, and introduced a resolution thanking Coms. Mooney and Marshall and the Navy Bureau of Aeronautics for extending to SAE the privilege of the first showing of this group of production technique pictures.

More than 400 members and guests crowded the ballroom where the pictures were shown.

Practical Experiences in Military Cold Starting **– LT.-COL. C. E. CUMMINGS, Ordnance Department.**

A COLORFUL and informal review of the military cold-starting experiences of most of the warring nations comprised Col. Cummings' presentation.

Emphasizing the vital importance of long and thorough preparation for cold-weather operation of military equipment, he said superior preparation explains in large part the success of the Russian winter offensives.

His discussion of various cold-starting methods and equipment included a comparison of their advantages and disadvantages for various types of service, and embraced both gasoline and diesel engines – liquid-cooled and aircooled.

"Heat is one basic requirement," he emphasized, adding that the engine fuel should be utilized to furnish the heat if possible. "Another is that the accessory equipment be simple and rugged so that it can be easily installed and serviced, and will stand up.

"Much credit is due to the SAE War Engineering Board and to the Cooperative Research Council for their assistance in our cold-starting work," Col. Cummings concluded.

The Elliott-Lysholm Supercharger **– ALF LYSHOLM, Aktiebologot Ljungstrom, Augturbin, Sweden; RONALD B. SMITH and W. A. WILSON, Elliott Co. (Presented by Mr. Smith.)**

TODAY, the application of supercharging to all types of engines, and particularly to diesel engines, is becoming more and more widespread. Of the many schemes for supercharging, Mr. Smith said that the mechanically driven positive-displacement compressor is very effective for the small high-speed engine and for the diesel engine that requires high torque at low speed.

The most common form of positive-displacement supercharger is the Roots-type blower, in which the air is trapped between the lobes and carried around to the exit where a back-rush of air from the discharge chamber raises the pressure of the charge. A number of machines have been developed to overcome the disadvantage of low internal efficiency in the Roots blower by providing compression within the cylinder.

"The Elliott-Lysholm rotary compressor," declared Mr. Smith, "was developed in an attempt to overcome the obvious shortcomings of vane- and reciprocating-type compressors by combining the advantages of high rotating speed, simplicity, freedom from rubbing contact, and internal lubrication, inherent in the Roots machine, with the desirable characteristics achieved by internal compression."

Although originally developed in Sweden, further experimental design work and testing are now being carried out in this country. To date, approximately 30 machines have been built and tested, varying in size from 15 cfm to 10,000 cfm.

Mr. Smith illustrated the advantages of the Elliott-Lysholm supercharger by describing a 400- to 500-cfm unit. Built of cast iron to obviate the distortion and high-temperature expansion of light metals, it weighs 80 lb completely equipped. The compressor is driven through a coupling or by means of a belt at from 2000 to 3000 rpm. A maximum adiabatic efficiency of 72% has been achieved, with performance over much of the speed range in excess of 70% for pressure ratios as high as 1.7. In fact, a characteristic exhibited by all Lysholm compressors is the flat curve obtained when efficiency is plotted against pressure ratio or speed.

The Lysholm compressor has already been built in sizes large enough to supercharge the biggest diesel engines that have been designed, Mr. Smith stated. He mentioned also that for the high-pressure supercharging now contemplated, their compressor offers an efficiency exceeding that attained even by the single-stage centrifugal-type and without the complication of auxiliary gear transmissions. Two-stage units operating at discharge pressures up to 100 psi have also been built. Light-weight units for aircraft service are also feasible, and are actually in the experimental stage of operation abroad.

DISCUSSION

Chairman Wilson opened the discussion by remarking that one of the requirements of a supercharger is that it compress the air sufficiently to make it worthwhile. He added that the high efficiency obtained by the supercharger described by the authors indicated that it certainly does live up to this requirement.

The first series of comments were made by H. L. Knudsen, Cummins Engine Co., who noted that the rotor lobe shapes were not symmetrical, so that it seemed as if they could not be generated but would have to be cut with a form cutter – or some sort of cam arrangement would have to be used if the cutting was done with a single-point tool. He questioned the authors' statement that no adjustment of compression ratio is desirable or necessary. He thinks that in the efficiency-pressure ratio curves shown for a 400-500 cfm compressor, it seems as if below a pressure ratio of 1.3 some sort of adjustment would be most desirable and perhaps better results would be obtained at higher ratios than are shown. He also wondered why a two-lobe construction was not used, as it would seem to be most desirable to reduce size and weight to a minimum.

W. L. H. Doyle, Caterpillar Tractor Co., thought that until scavenging was fully adopted for the 4-cycle diesel engine, including alterations in valve timing and exhaust manifold systems following Buchi principles, the full advantages of supercharging would not be realized. He feels a valuable contribution would be made if the authors would show comparative performance data between their supercharger and a Roots type of blower of similar capacity – both blowers to have the same housing-to-rotor clearances radially and axially.

Several more questions were brought up by Ralph Miller, Worthington Pump & Machinery Corp. and H. O. Hill, American Bosch Corp. The co-authors each took a turn at replying.

One question about the number of lobes was answered by Mr. Wilson, who said that not all Lysholm superchargers have the same number of lobes on each pair of rotors; however, the fundamental geometry is independent of the number of lobes and whether the combination is three and four, four and six, or three and three.

The point that the unsymmetry of the rotors would make it difficult for the manufacturer was then answered by Mr. Wilson, who said that the problem of manufacturing the rotors was not as real as it seemed.

He said further that the positive displacement blower is ideally suited to the positive displacement engine because of matched characteristics. He also cleared up a point about the indicator cards. Even those labeled "actual" had not actually been taken as the result of a test, but were merely the authors' attempt to depict theoretically what they thought actual cards will show when they have developed a technique for taking them.

Comparative tests of Roots and Lysholm superchargers of similar size have been run and the results are decidedly in favor of the Lysholm. The Lysholm also has a lower noise level, because it is operated at higher speeds than the Roots blower is. This means higher frequencies are obtained, the intensity of the noise is lower, and therefore less extensive absorbing material is needed.

Further remarks were made by Mr. Lysholm. He discussed the problem of the number of lobes to be used, saying that for a compression ratio of two or three, between four and six lobes provide the best compromise. A smaller number of lobes does not give sufficient compression and a larger number requires that too deep recesses be cut in the lobes, thereby making them extremely flimsy.

In answer to several questions as to how the superchargers were tested, Mr. Smith said that the actual power was measured in a dynamometer, the flow was measured by a standard orifice, and actual delivery was measured at the intake.

Hamilton-Whitfield Blower – J. E. WHITFIELD, General Machinery Corp.

GENERAL design features of the new and highly successful Hamilton-Whitfield blower were presented by Mr. Whitfield. Development of a blower might appear on the surface to be a comparatively simple matter, but Mr. Whitfield explained that plenty of complete failures and many less drastic troubles were experienced for 10 years before his first satisfactory blower was built.

The Hamilton-Whitfield blower is of the axial-flow screw type, having thread forms that can be simply and accurately generated and that provide a continuous seal between inlet and discharge at all times whether the rotors are operating or are stationary.

As a result of performance tests, Mr. Whitfield was able to report that his blower gave higher volumetric and over-all efficiencies and a noticeably lower noise level at both the intake and discharge sides than previous types of blowers. Because of a reduction in vibration and various mechanical improvements, the new blower is suitable for high-speed operation; hence the size of the blower may be reduced.

Mr. Whitfield also discussed some of the construction details of the blower. He emphasized that the entire main rotor assembly including the bearings, bearing carriers, seals, and timing gear can be assembled and disassembled as a unit. The same is true of the gate rotor except that the timing gear is removed from its hub by unbolting. Self-aligning spherical roller bearings are used to compensate for distortions in the case caused by the differences in temperature between the intake and discharge sides.

A rotor speed ratio of 2 to 1 is used because this ratio gives the maximum capacity for a given size of bulk. Aluminum bronze is used to replace aluminum for the rotors because this material gives freedom from seizing, flows readily in thin sections, has high strength, and has a low rate of expansion.

To allow for constant airflow regardless of the direction of rotation, as when reversible engines are used, a reversing valve has been developed that is built directly into the blower case. An effective resilient drive is provided for diesel engine use.

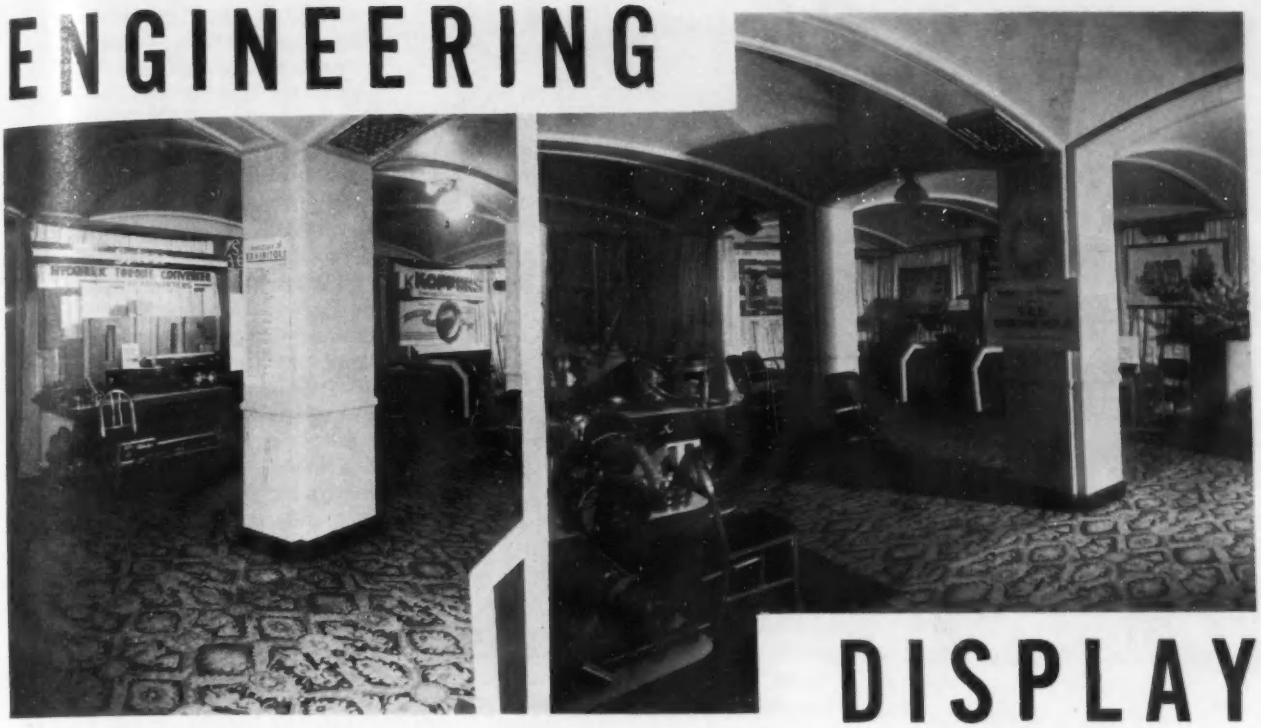
DISCUSSION

The noise reduction and better efficiencies that were claimed were very gratifying to Mr. Knudsen, who remarked that unless we could better the performance of the Roots blower, we are at a standstill in our supercharging program. He thought the fact that rotor forms could be generated would in itself insure greater efficiency – not only in manufacturing, but also by making it possible to work to closer tolerances.

An automatic adjustment of the compression ratio, if practical and not too complicated, it seemed to him, would be a worthwhile feature when the blower is used in variable speed engines where the pressure ratios may vary considerably.

The assembly and adjustment of the timing gears is done in the factory and the timing need never be checked again, was the reply of Mr. Whitfield to a question as to how often timing is necessary. He said that the parts are doweled together, so that they can be taken apart and put together without further adjustment, very easily.

ENGINEERING DISPLAY



WITH the national colors predominating in the displays, many of which included elaborate background panels presenting technical information concerning the exhibits, the tenth consecutive SAE Annual Engineering Display opened at the Book-Cadillac Hotel, Detroit, Jan. 11, continuing until Jan. 15.

A big increase over last year in the number of companies represented placed a premium on available space and several concerns shared their booths with other manufacturers.

AEROQUIP CORP. A panel display and operating demonstration of self-sealing "quick disconnect" couplings and detachable hydraulic hose fittings was presented by this company. The couplings permit uncoupling hydraulic lines without loss of hydraulic fluid, through the use of valves which close when the coupling is opened. The hose fittings are designed for quick detachment from the hose and are reusable. Hose can be cut to length in the field and fittings remounted by use of a simple detaching and attaching tool. They have been tested to remain in position at pressures of 4000 psi and up.

AIRCRAFT SCREW PRODUCTS CO., INC., with an elaborate illustrative panel, numerous reports, folders and samples showed its new Aero-Thread system in which a drawn stainless steel or bronze wire is coiled and fitted between the mating threaded parts, both of which are equipped with a special thread developed by the company. Use of this new fastening method "doubles the fatigue resistance of threaded fastenings," according to tests. Also shown was a new "Heli-Coil" spark plug bushing wherein the hole is tapped for the special thread, the coiled steel wire bushing interposed and the inner thread of SAE standard metric form.

ALUMINUM CO. OF AMERICA in its display this year, laid special emphasis upon methods of fabricating aluminum, including recommended brazing and welding techniques. Descriptive and instructional booklets were available to visitors and technical motion pictures were shown in the company's rooms at the hotel to those especially interested in various fabricating processes. The Mazlo line of products of the American Magnesium Corp. was also illustrated.

ALUMINUM INDUSTRIES, INC., featured samples of sand and permanent mold magnesium castings, as well as those of aluminum. Most parts now being made by the company are for aircraft. Some of the parts exhibited included an aluminum carburetor throttle body, numerous flanged fittings, a large nose casting of magnesium, and several brackets in both aluminum and magnesium.

AMERICAN BOSCH CORP. displayed its new induction vibrator for engine starting, in which a continuous vibrator is introduced into the primary circuit of the magneto, the magneto secondary coil producing the high-tension current. For airplane engines it was stated that no additional spark-retarding mechanism is necessary when the vibrator is used, although for tank engines the magneto is equipped with a spark retarding governor. The company's complete line of magnetos for engines from 7 to 18 cyl was also shown.

AMERICAN PHOTOCOPY EQUIPMENT CO. presented a complete demonstration of its low-cost method of making photocopies, including printing, developing and drying. The company's printing machine features a curved glass surface over which the pieces to be printed and the sensitized paper are tightly held by means of a spring-tensioned curtain. The curved surface is used to obtain equal light distribution and to reduce the electric power required for operation.

BLACK DRILL CO. In addition to a demonstration of its drills for drilling hardened steel, the company presented

its line of tool bits, special tools, and reamers. The bits are for rough hogging cuts on tough alloy steels and hard non-ferrous alloys, and are made of the drill material. The reamers have been developed to obtain extreme edge hardness without disturbing the resistance of the material to abrasion and are thus intended to replace reamers of high-speed steel, where long production life and maintenance of accurate hole size are especially desirable.

CLEVELAND GRAPHITE BRONZE CO. Against a background panel of red, white and blue, the conservation of critical materials through the use of steel-backed lead babbitt bearings was featured. A new copper-lead alloy was also emphasized. By permitting reduced thickness and using the steel back, the total poundage of critical materials may be decreased to as low an amount as 25% of former quantities required. Clutch plates of sintered bronze on steel were shown.

CONTINENTAL MOTORS CORP. exhibited one of its "Commando" gasoline engines designed for heavy-duty marine applications. This engine is of the 6-cyl type, with overhead valves. It is cast en bloc, with separate heads and valve cover for each set of three cyl. It has a piston displacement of 602 cu in. and is equipped with shielded ignition, military type oil filters, gear type water pump, water-jacketed exhaust manifold, and fully enclosed reverse gear.

DE LUXE PRODUCTS CORP. In addition to its regular line of lightweight cast iron pistons, a new "Clear-Ex" device designed to reduce the amount of burned gases remaining in the combustion chambers was shown. Reduction in obnoxious odors, improved fuel economy, decreased carbon monoxide content of the exhaust and other advantages are claimed for this unit. A display of the company's line of oil filters and internal parts rounded out the exhibit.

EX-CELL-O CORP. While making precision machines for various manufacturing operations and a line of diesel injection pumps, the company has also developed a new nozzle tip which requires no adjustment in service and is interchangeable with other makes of tips. Several panel displays explained the applications of the company's precision thread grinders and boring machines. Diesel fuel injection equipment on display included pumps of both fixed and timing advance types, screw and clamp type nozzles for gasoline as well as diesel fuel.

FRAM CORP. mounted at eye-height for easy study by visitors a complete demonstration model of the Fram oil filter. Illumination of the working display served to reveal clearly the effectiveness of the filter in reducing oil contamination and in cleaning the lubricant. Black, contaminated oil from the sump was in part put through the filter, in part by-passed, the adjacent down-streams of dirty and clean oil indicating by comparison the efficiency of filtering.

GARLOCK PACKING CO. A complete display of ring and other types of packings, gaskets, and oil seals with wide applications in aircraft, motor vehicles and similar units was shown. Packings suitable for use in hydraulically operated landing gears and many sizes of shaft seals for various purposes were also exhibited.

GEMMER MFG. CO. showed its steering gear equipped with a shock-arresting device arranged in a special stand, which showed on a screen how the device operates. It consists of a locking bar mounted in an extension of the lower worm bearing cup. The bar turns freely in a ring when actuated by the steering wheel, but locks when the steering or pitman arm becomes the driving element. In use about two years, the device is used in steering gears for heavy vehicles such as dump and off-the-road trucks, road grading machines, and semi-track units which are front-wheel steered.

JAM HANDY ORGANIZATION. With a broad line of visual training aids consisting of slidefilms, motion pictures, and other instructional material available for teaching new workers, this organization is placing special emphasis on pictures for instructing aircraft mechanics on virtually every subject required for the war effort. Training films include such subjects as fabric covering operations, cable splicing, cleaning and painting, tires, brakes, landing gears, soldering, tube fabrication and many others relating to manufacturing and repair, as well as more advanced topics.

HARRIS - SEYBOLD POTTER CO. demonstrated a Morrison wire stitching machine capable of stitching together two or more pieces of aluminum, steel, textiles, rubber, plastics, etc. The wire used in the machine punches its own holes for the stitches, which are clinched flat after passing through the material. The machine is said to be capable of stitching up to 0.1 in. total thickness of two or more pieces of ST aluminum and a much greater total thickness of SO aluminum. The wire size is 0.057 in. including thickness of zinc coating. Tests have shown each stitch as strong as a ⅛ in. aluminum rivet, with a stitching speed approximately 30 times faster than riveting. The method is also suitable where spot welding has been used.

HAYES INDUSTRIES, INC., in order to illustrate an important application

for its hydraulic expander tube brakes, displayed a complete main landing gear unit for the B-17F Boeing Flying Fortress, including oleo, torsion links and axle, 56 in. wheel and tire. (Oleo, links and axle were manufactured by A. O. Smith Corp.) The expander brakes used in the wheel were dual 20 x 2¾ in. duplex type similar to those in use on the Consolidated B-24 Liberator airplane. Outstanding features of the brakes are their large areas in proportion to drum diameter, ability to furnish braking action equally in either direction, low weight and equalization of application pressure even when drums are eccentric or out of round. A complete table display of the various sizes of brakes included samples ranging from 5 to 20 in. diameter, suitable for liaison and other types of planes, with cut-away assemblies to show details of design. Brake shoes of conventional type for military training planes such as the AT 6 and 9 were similarly exhibited.

HERCULES MOTOR CORP. devoted its space to a large, tinted, cross-sectional photographic presentation of one of its characteristic designs of a 6-cyl diesel engine. The presentation revealed operating and construction details, indicated the flow of fuel and lubricant, and provided practical information on the engine. It was explained to visitors that the engine is one of the many units Hercules is supplying for use in motorized war equipment.

HICKMAN PNEUMATIC SEAT CO., INC. In addition to displaying the Hickman seat for buses and trucks, which features an "engineered ride," space was devoted to a scale model demonstration of a gravity spring tandem axle suspension system for trucks and trailers. The system is a further development of the torsion rod suspension system in use by a bus manufacturer for more than three years and provides automatic axle alignment with extreme vertical and lateral flexibility.

KOPPERS CO. Against a red, white and blue panel background containing a revolving circular transparency, illustrative of the numerous airplane engine applications of the firm's line of American hammered piston rings, samples of rings were mounted in slots in the display where they could be examined. The company's products are used extensively in Army and Navy applications.

LORD MFG. CO. featured its bonded rubber mountings in an elaborate panel and table display. The panel display emphasized torsional and shear type mountings for engines. A table directly in front of the panel included an exhibit to demonstrate the natural frequencies attainable with rubber mountings and why these frequencies should be avoided when designing mountings for isolating vibration.

MONROE AUTO EQUIPMENT CO. displayed a wide range of shock absorbers used on various types of equipment from motorcycles to railroad cars. The exhibit revealed the application of hydraulic cylinders to the task of controlling the movements of guns and turrets on motorized war equipment. This is a recent development by Monroe, worked out in cooperation with the military.

MOTOR MAGAZINE. The exhibit of this well-known automotive publishing organization emphasized one of its new publications – a motor truck repair manual designed particularly as a contribution to the war effort. The book is intended for all grades of mechanics and may be used both for study and reference purposes. Overhaul instructions are given for all makes and models of delivery cars and trucks built during the years 1936 to 1942. The book contains more than 900 large pages and some 1400 mechanical illustrations. There is a complete diesel servicing section.

MOTOR PRODUCTS CORP., DEEP FREEZE DIVISION. Three units capable of producing below-zero temperatures were displayed. They range in cooling capacity up to a heat absorption rate of 1000 Btu per hour and a temperature of minus 120 F. A new unit for temperature of —70 F is designed for industrial chilling requirements of war industries, including low-temperature testing of aircraft instruments, various materials, storage of annealed aluminum alloys, etc. The unit producing temperatures of around —120 F is useful in the heat treatment of high-speed steel in addition to other applications.

PETROLEUM ADVISERS, INC. (FOR CITIES SERVICE OIL CO.) presented a new exhaust gas analyzer designed for aviation use, which operates on 24-v d.c. and can be taken on actual flight tests for checking exhaust gas constituents. The unit has been tested at altitudes of 25,000 ft in actual flight. Two immersion oil heaters of convection type were also displayed. One is for permanent attachment in the crankcase, the other for outside attachment by flexible tubing, as may be required for heating oil in wing-mounted tanks.

The ability of one low cold-test oil to remain liquid at below zero temperatures was shown by two watches surrounded by dry ice. The watch lubricated with ordinary watch oil would become inoperative at these temperatures, whereas the one lubricated by the low cold-test oil would continue to run. Another demonstration showed the effectiveness of a new solvent to remove varnish, carbon, etc., for cleaning engine parts.

PHYSICISTS RESEARCH CO. displayed and demonstrated its profilom-

eters and accessories, including several new attachments. A new tracer eliminates the need for adjusting the diamond. Another new tracer is designed for checking the surface finish of the small holes in shell dies. Still another is designed to measure the finish on internal diameters as small as 0.090 in. Designed for measuring internal diameters around ¾ in. to depths of 18 in. and capable of checking the surface either radially or circumferentially, a new "long type" tracer has been developed.

REMINGTON RAND, INC. exhibited one of its complete line of photocopying machines. This machine, finished in natural walnut, is capable of handling prints 32 by 45 in. The line includes small portable machines for office use as well as continuous types for reproducing any length of drawing with a maximum width of 42 in. The machine affords a means of duplicating almost any subject, including direct copying from blueprints, documents, drawings in pencil, letters and photographs. Where unity or reduction copying is required, the company offers a reproducing camera.

RESEARCH PRODUCTS CORP. Air filters for industrial and household air-conditioning applications and silica gel dehydrating material were exhibited by this company. The air filter cells are designed for use either singly or in banks, and when outer faces become clogged they may be detached and ripped off, thus restoring the filter to original efficiency. The silica gel was displayed in both natural (white) color and treated with cobalt. In the latter condition it indicates the amount of moisture absorbed by changing color. The material can absorb 40% of its weight in moisture.

SPICER MFG. CORP. with a background emphasizing its position as "torque converter headquarters," exhibited many parts and assemblies used in war vehicles, including a "jeep" front axle, clutches, gears, a spur gear type differential unit, universal joints and shafts. The company is producing parts and assemblies such as these in large quantities as its contribution to the war effort. A large torque converter and a transmission assembly were shown.

STEWART-WARNER CORP. used photographic enlargements and montages to show the application of its many different products to military uses. One panel was devoted to illustrating the utilization of the "South Wind" heater in military planes. Another panel showed the various pieces of Stewart-Warner equipment now being used in "jeeps," tanks, motorized artillery pieces, "mosquito boats," and landing barges.

TINNERMAN PRODUCTS, INC., now engaged in producing attachments almost exclusively for aircraft, displayed an almost endless variety of speed-nuts, speed-clips, shop-nuts for preliminary riveting and other assembly operations and numerous additional non-structural applications. A new pulley bracket with universal joint feature, which eliminates many difficulties in aligning pulleys for controls and simplifies assembly, was shown. A new harness clamp for faster attachment of wire bundles, specially formed speed-nuts for use in plywood, a new "speed-align" adjustable fairlead guide block, conduit clamps, new twin type speed-nuts, and a new speed-nut retainer ring were a few items displayed.

TUBING SEAL-CAP, INC. displayed its line of tubing and pipe closures including threaded caps and plugs, and flex-caps. A feature of the various types and sizes of caps and plugs is that they may be used repeatedly, hence are not only used for protection in shipment, but have found extensive shop use during processing operations. The company also displayed a new line of torque wrenches which utilize a deflection bar in combination with a snapping spring to indicate the correct amount of torque. The wrenches are pre-set for assembly work and can be checked quickly by assembly inspectors without special equipment.

TORRINGTON MFG. CO. Utilizing a photograph panel display to show applications, the wide range of sizes of fans made by this company was indicated. The line includes fans with sirocco type rotors and those of propeller bladed type, ranging in size up to 24 in. in diameter for the former and 48 in. for the latter. Rotors for the smaller fans were displayed.

VICTOR MFG. & GASKET CO. In addition to its line of gaskets for cylinder heads and other applications, a new oil seal for the ball joint of a large armored truck front axle was presented. The seal of a new material called "Victoprene" prevents loss of the thin oil used in the front drive joint of this axle. The seal is 11 in. in diameter. Seals of similar design up to 14 in. in diameter were also displayed.

WAUKESHA MOTOR CO. displayed a large panel showing a cut-out cross-section of the Waukesha "Multi-Fuel" engine designed to operate with equal facility on oil, gas, or gasoline. The illustration indicated the use of a fuel injector for oil fuel, and of a specially-designed carburetor for operation on gas and on gasoline.

S. K. WELLMAN CO. displayed its line of bimetallic friction materials extensively used for clutch facings and brake shoes. The material is made from powdered metals, graphite and other powdered substances and is welded to steel plates either on one or both sides, thus obtaining adequate structural strength from the combination. Various compositions are used to obtain desired characteristics in various applications.

ZOLLNER MACHINE WORKS utilized its parlor space for a display panel and conference quarters. The panel brought out that the company now is engaged entirely in the production of pistons for the many types of engines used in the war effort, including pistons for diesels and two-stroke engines.

Advantages of Materials Variety Useless If Not Readily Obtained

▪ Southern California

"Standardization of materials – chemically, physically, and dimensionally – has been found necessary to facilitate production of aircraft," stated Carel T. Torresen, outside standards engineer, North American Aviation Co. Mr. Torresen spoke before the Southern California Section meeting of Jan. 8.

"It will be recalled," he continued, "that prior to the opening of the war, many materials were developed in a lavish age. The many types and sizes were found increasingly difficult to obtain. Difficulty in the manufacture of the numberless varieties prompted intensive study. Self-imposed standardization came to the fore.

"We are well aware of the benefits to be derived from a wide variety of materials," Mr. Torresen said. "The drop forger, for instance, may guard against decarburization of some of the low carbon moly steels, perhaps by using a shade higher carbon content, for moly steels are susceptible to decarburization.

"The welder may be better prepared for consistently good welds by having at his disposal steels of controlled carbon and grain size.

"All the advantages of manifold selections of materials are nothing, however," he emphasized, "if these materials may not be readily obtained."

Meetings held for purposes of standardization have brought together men of diverse interests. It has been difficult for an occasional employee to submerge his company's special interest in favor of majority opinion. Actual standardization is much more readily accomplished by men employed in the occupations affected by the standard than would otherwise be the case, the speaker said. He reported, for example, the performance of the SAE in the task of generating the Aeronautical Material Specifications.

Mr. Torresen described the standards engineer as one who selects materials for use in manufacture. He must also determine the dimensional sizes of these materials for best purchase and storage, with full cognizance of the demands of the designer. The standards engineer acts as a partial brake to the fancies of the research and design engineers by putting a reasonable limit to their choice, and he acts as an accelerator to the purchasing and manufacturing departments by making materials more suitable for mass production.

"Strategic Materials – Aircraft Production and Design," by J. E. Barfoot, stress and test engineer, Douglas Aircraft Co., was also presented.

"In dealing with the subject of strategic materials from the standpoint of production and design, the problem may be broken into two main divisions: the production problem that confronts us at the present time – that of substituting one material for another due to a particular subcontractor – or our own inability to meet delivery dates – in other words, a temporary material shortage. And secondly, the later problem of not having sufficient material of any reasonable kind with which to fabricate our airplanes.

"In the early part of 1942 the War Production Board set up standards for new alloys, National Emergency (NE) steels, which contained less of some strategic material," Mr. Barfoot reported. "It was also intended by the WPB that these alloys should supplant the numerous SAE alloys and permit steel manufacturers to concentrate on a fewer number," he added. Probably this objective will ultimately be accomplished, but the immediate result has been only to add several new alloys to the already long list of SAE alloys, Mr. Barfoot believes.

He listed some of the specifications prepared by the Bureau of Aeronautics in cooperation with the Army Air Forces and the Army-Navy Aeronautical Board.

The second part of Mr. Barfoot's discussion concerned the possibility of not having

Among those who participated in the Southern California Section Meeting were (left to right): T. D. MacGregor, Douglas Aircraft Co.; Carel T. Torresen, North American Aviation Co.; E. S. Crocker, Wiggins Trade School; George Tharratt, Adel Precision Products Corp., aircraft vice-chairman of the Section, and J. E. Barfoot, Douglas Aircraft Co.

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sufficient material with which to fabricate our airplanes, unless some long range planning is effectively put into operation. The speaker confined himself only to structural materials which are essential to the design of the average military airplane.

Among the questions raised by the speaker were:

- Has any agency made, or is any going to make, a study of the number and size of airplanes that we are contemplating fabricating in the next two or three years, possibly using our increasing rate curves as a basis for estimate?
- Has any individual or body made an estimate of each specific material necessary to produce these airplanes?
- Will proper designation be made to the materials manufacturer concerning the quantities he must produce and at what time, to meet the demands?
- Will the airplane fabricators be supplied with the materials, and at the time they need them?
- Will a balance between supply and demand be effected so that neither the materials manufacturer nor the airplane manufacturer will be caught holding the proverbial "sack?"
- Why not, as an initial step, force every major manufacturer to declare the quantities he now has in stock, much in the same manner that food is declared when rationed?
- How about manpower? Who will see to it that every manufacturer of either materials or airplanes gets his just share?

Mr. Barfoot believes that the War Production Board, the Army and Navy, the Maritime Commission, the Lend-Lease Administration, the Board of Economic Warfare, and many others are cooperatively preparing, have had, or will have in operation, plans of action to take care of the most essential of these questions.

Tractor Activity Committee Renamed

The SAE Council has approved the change in name of the Tractor and Industrial Activity Committee to Tractor and Farm Machinery Activity. This change went into effect immediately following Council approval at its Jan. 10 meeting.

Well-Known Research Director Presents Glimpse of Future Aircraft Design

▪ Southern New England

Although admittedly speaking within the restrictions of wartime expediency, Frank W. Caldwell, director of research, United Aircraft Corp., nevertheless laid out a substantial program of investigation and development when he spoke before the hundred and more members and guests of the Southern New England Section on Nov. 18. "Trends in Aviation" was Mr. Caldwell's subject.

He spoke first of the general problem of range, predicting that it would eventually be found to have a definite limit. He treated four factors affecting range: L/D ratio of the airfoil, propeller efficiency, fuel consumption, and structural efficiency, the last as measured by the ratio of useful load to total load. He suggested that the first of these is being improved by increase in aspect ratio, 12½ being the latest, and that removal of the boundary layer by blowing or sucking it away seems a promising development, particularly if we go in for jet propulsion. Not much improvement is to be expected from increase in propeller efficiency; increase in structural efficiency awaits the development of better materials. He stated that the outstanding hope for increasing range lies in the ceaseless efforts of the engine manufacturers to reduce fuel consumption.

Speaking of fighter development, Mr. Caldwell pointed out that maneuverability has been more and more sacrificed to speed since the last war, and that the increase in speed which has been achieved is inseparable from the increase in altitude of operation.

Mr. Caldwell then spoke about transport planes. He stated that demands for frequent service would require the continued use of moderate-sized planes; that saturation of air traffic in the neighborhood of large centers would require the continued development of larger planes, and that overseas service would probably utilize planes carrying 100 to 150 passengers. He mentioned that cargo service to places overseas to which fuel has to be transported by boats offers no economic advantage as yet; that its advantage is limited to emergencies in war and peace. He predicted that in pick-up service, the helicopter seems a useful development since it should have, with its other recommendations, a good ratio of useful load to total weight.

Some form of jet propulsion, accompanied by changes in heat cycle, in the ratios of air to fuel, and increased cruising speeds (above 300 mph) offers hope, at least, for lowering the limit of fuel consumption set, at present, by the screw propeller. Mr. Caldwell stated that at 40,000 ft and 150 mph the propeller and engine combination is twice as good as the jet, that at 300 mph neither has the advantage over the other, whereas at 550 mph the jet is twice as good as the engine-propeller combination. He described briefly two well-known jet-propulsion devices, one German and one Italian; the fuel economy of the first of these is too poor, and the weight of the second is too great for practical consideration.

The future of private flying, Mr. Caldwell admitted, seems difficult to evaluate. He expressed considerable interest in the helicopter, specifically mentioning its advantage over the conventional type for operation in thick weather.

Finally, the future of the enormous plant capacity we now have devoted to aircraft manufacture was considered. Obviously we shall not need it all for the demands of peacetime expansion. On the other hand, it seemed equally obvious to Mr. Caldwell that there was no lack of work awaiting the engineers from this point forward.

The members of SAE-ODT Committee No. 6 – Metal Coating – Applications and Technique – located on the Pacific Coast, meet in Los Angeles to prepare a report. Seated left to right: Herman Fox, Consolidated Rock Co., Gus Martin, Pacific Freight Lines, Robert N. Reinhard (chairman), Golden State Co., Ltd., C. R. Forsberg, Los Angeles Automotive Works, E. W. Templin, Los Angeles Bureau of Power and Light, Major W. M. Britton, W. M. Britton Co., Charles Boyden, Metallizing Co. of America, E. Berry, Precision Engineering Co.

Predicts Synthetic Will Rival Natural Rubber in Two Years

▪ New England Section

"Tires will outlast the life of cars and 75,000 to 100,000 miles will be the usual mileage when the war ends and the country starts on a peacetime basis again," Robert F. Lybeck, automotive and aeronautical sales manager, Colonial Beacon Oil Co., Boston, predicts. Mr. Lybeck spoke about synthetic rubber before the New England Section Dec. 10.

"Today in many respects, particularly wear, synthetic rubber tires and tubes are already better than natural rubber," he pointed out. In addition, the synthetics satisfy many uses not filled by the natural product. The bullet-proof gasoline tank is the most outstanding example. This is possible because synthetic rubber is not readily affected by gasoline, he said.

"A new $1,000,000,000 American industry – synthetic rubber – is being built in a relatively few months," Mr. Lybeck disclosed. He believes that this baby industry will rank in size with our automotive industry and the entire chemical industry, and that in two years it will rival the 98-year-old natural rubber industry.

Mr. Lybeck emphasized the importance of rubber in reaching our victory goal. "Through the sensational development of

this new product, we will cut the bonds of natural rubber, and the United States will never again be dependent upon foreign supplies," he declared.

Next year will be a critical year in our war rubber program, he believes. Although synthetic rubber is well on the way the maximum 1942 output will be sufficient to take care of our primary military needs only, and such civilian needs as are absolutely necessary. But if the present program is carried to completion, 1944 will see the dawn of better days, he said.

WAACS 'Take Over' Washington Meeting

▪ Washington

On Dec. 8 the Washington Section held its first "Ladies Night" at the Mayflower Hotel. The entire program was given over to the Women's Army Auxiliary Corps.

Lt. Julia M. Kirby, assisted by Lt. Marion L. McAdam, explained that the fundamental purpose of WAACS is to take over such jobs in the Army as they are capable of doing well, and thus release men for combat service. Many thousands are already in training for this work, and the Corps will be expanded as rapidly as is possible.

Applicants for WAACS must be between the ages of 21 and 45, inclusive; must be between five and six feet tall and have a minimum weight of 100 lb. They must be American citizens, but no specific education requirement is set up, they explained. A premium is put on mental alertness and adaptability and the Army physical test must be passed.

The specific jobs in the Army that WAACS will undertake have not yet been clearly outlined. They have already been assigned to four groups, however – Administration, Communications, Motor Transport, and Academic – and other groups may be added later. WAACS will not undertake assignments in Army units as individuals, but will go as detachments or units to handle their specific jobs.

Col. McInerney and others commented on the value of the contribution to the war effort which is being made by SAE committees.

Sand Proves to Be Greatest Menace in African Maintenance Procedures

▪ Mohawk-Hudson Group

In an informal talk, most of which was off the record, R. D. Mires of the General Electric Co. described some of his experiences in setting up maintenance procedures for the Royal Air Force in Africa. Mr. Mires spoke before the Group's meeting of Dec. 8, held in Albany.

Working on American planes, his party set up assembly lines to overhaul engines and ships, he related. Among the problems encountered was the shortage of tools, which were not always available because of shipping delays. However, wrenches to fit our American ships were fashioned out of flying wires from discarded planes.

This tool shortage was but a secondary problem; sand was the main cause of trouble. This fine sand, not beach sand as we know it but more like talcum powder, penerates into all dwellings no matter how well built. The men in Africa practically sleep, eat, and live *sand*. Because it is impossible to keep such a penetrating substance out of the engines of the ships, the life of an engine operating under these conditions is but a fraction of what is normally expected. This causes frequent overhauls, and it is necessary in such an operation to have three or four engines for each ship. They are kept in constant circulation from the front to the repair shop.

Following Mr. Mires' talk, sound movies were presented. "Cyclone Combustion," by the Wright Aeronautical Corp., and "Airborne Command" and "Aeronautical Oddities," by the Army Air Forces, were shown.

War Conditions Emphasize New Materials Development

▪ St. Louis

Speaking particularly from the viewpoint of truck and bus manufacturers and operators, Robert Cass, chief engineer of the White Motor Co., said that materials substitutes necessitated by war conditions will not bring about many great changes. The title of his paper was "Automotive Engineering Now and Post War," and was presented before the St. Louis Section on Dec. 10.

The present situation in regard to the supply of steel for such parts as gears is better than it has been in recent months, he believes. To date, critical parts such as gears are no more than 10% worse, from the standpoint of life expectancy, than the gears made of the somewhat superior materials heretofore available, he asserted.

Mr. Cass pointed out that the lowered octane rating of gasoline is causing trouble with engines designed to take advantage of the pre-war fuels, but he thinks the driver can overcome such trouble by careful operation of the vehicle.

As for substitute materials, Mr. Cass feels that, in general, the substitutes hold little promise for the future. However, he cautioned against confusing substitutes with development of new materials, and stressed the effect of war on development of materials. He then reviewed some developments resulting from World War I, which probably would have been long delayed except for conditions arising out of the war. He cited the development of synthetic rubber as an example of this type of progress. Other materials which the war is bringing into more common use are magnesium, aluminum, and high-octane gasoline. Plastics are also receiving great emphasis in development.

In general, the design changes of the future will be dictated by our postwar economy, and secondly, by considerations of comfort and safety.

A sound film on "Combustion," prepared by the Wright Aeronautical Corp., concluded the meeting.

Action Shots of Armored Forces Shown

▪ Metropolitan

"Tank Power Plants" was the topic of the Dec. 10 meeting of the Metropolitan Section. The paper was prepared and presented by Major Howard R. Hammond, formerly of the Caterpillar Tractor Co., and now a member of the Armored Forces Board, Fort Knox, Ky. Unfortunately, neither the paper nor the ensuing discussion can be published at this time due to censorship restrictions.

Major Hammond also presented a color moving picture, "Tanks in Action." This film was taken at Fort Knox, and it contained many action shots of the various tanks and other mobile fighting equipment used by the armored forces.

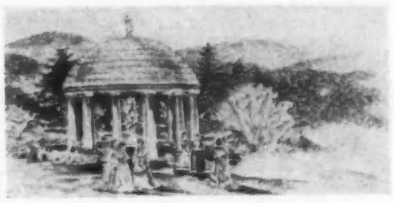
Past-chairman Clayton Farris was presented with a framed testimonial of his service to the Section. The scroll was signed by each member of the Governing Board who worked with Mr. Farris during the 1941-42 season.

Good-by Forever!

The Greenbrier Hotel at White Sulphur Springs, site of many of SAE's most successful Summer Meetings, has been sold to the U. S. Government.

With the 162-year-old hotel and its furnishings went its 6500 acres of wooded grounds, farm lands, casino, swimming pool, and three golf courses. Sale price: $3,300,000. Use: Army hospital.

Twenty years ago the first of 10 SAE Summer Meetings was held there.



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SAE Coming Events

April 8-9

SAE National Aeronautic Meeting
Hotel New Yorker – New York City

Buffalo – Feb. 10

Hotel Markeen; dinner 6:30 p.m. Symposium on Aircraft Production.

Chicago – Feb. 9

Hotel Knickerbocker; dinner 6:45 p.m. America's Trucks – Keep 'Em Rolling – Fred L. Faulkner, automotive engineer, manager, Automotive Department, Armour & Co.

Cleveland – Feb. 8

Cleveland Club; dinner 6:30 p.m. Aircraft Testing and Maintenance Procedures – M. B. Crawford, sales engineering and service manager, Pump Engineering Service Corp.

Colorado Club – Feb. 16

Union Station, Denver. Demonstration on Model Locomotives.

Dayton – No meeting

Detroit – Feb. 15

Aeronautical Meeting.

Indiana – Feb. 18

Antlers Hotel, Indianapolis; dinner 6:30 p.m. Rational Testing of Motor Fuels – H. M. Jacklin, Professor of Automotive Engineering, Purdue University. Movie.

Metropolitan – Feb. 18

Hotel Edison, New York City; dinner 6:30 p.m. Driver Selection and Training – Milton Kramer, New York University; consultant to Quartermaster General on driver selection and training. "Motor Marches in Convoys" and "Difficult Driving" – movies from Signal Corps.

Milwaukee – Feb. 5

Milwaukee Athletic Club; dinner 6:30 p.m. Trend in Friction Material – C. H. Schell, research engineer, Thermoid Co.

Northern California – Feb 20

St. Francis Yacht Club, San Francisco; dinner 7:30 p.m. Annual Dinner Dance.

Oregon – Feb. 12

Oregon State College, Corvallis; dinner 6:00 p.m. Annual Student Meeting. Chairman – Prof. W. H. Paul, Department of Mechanical Engineering, Oregon State College.

Southern California – Feb. 5 and 19

Feb. 5 – San Diego. Aircraft Meeting. Chairman – E. T. Price, president, general manager, Solar Aircraft Co.

Feb. 19 – Clark Hotel, Los Angeles; dinner 6:30 p.m. Truck and Bus Meeting. Chairman – John Wiggers, chief engineer, Crown Body and Coach Corp.

Southern New England – Feb. 17

Hotel Bond, Hartford, Conn.; dinner 6:30 p.m. Air Power in Action – Major N. F. Silsbee, U. S. Army Air Forces.

Washington – Feb. 9

Speaker – Representative of U.S.S.R. Purchasing Commission.

APPLICATIONS Received

The applications for membership received between Dec. 15, 1942, and Jan. 15, 1943, are listed below. The members of the Society are urged to send any pertinent information with regard to those listed which the Council should have for consideration prior to their election. It is requested that such communications from members be sent promptly.

Baltimore Section

Bowman, W. S., junior engineer, Proof Division, Aberdeen Proving Ground, Md.

Canadian Section

Baer, George A. C., president and general manager, Clyde Aircraft Mfg. Co., Ltd., Collingwood, Ont.

Boyd, James Masson, manager, lubricants department (sales), Shell Oil Co. of Canada Ltd., Toronto, Ont.

Elliott, George K., manager, Wagner Brake Service Co., Ltd., Toronto, Ont.

Kidd, Karl William, manager, commercial tire sales department, Goodyear Tire & Rubber Co., New Toronto, Ont.

Prefontaine, C. E., president and general manager, United Auto Parts Ltd., Montreal, Que.

Symons, John W., tire engineer, Dominion Rubber Co., Ltd., Kitchener, Ont.

Chicago Section

Anderson, E. B., chief engineer, Mechanics Universal Joint Division, Borg-Warner Corp., Rockford, Ill.

Groenier, John, partner, Axel & Equipment Sales Co., Chicago.

Guerasimoff, Constantine N., assistant chief engineer, The Buda Co., Harvey, Ill.

Hay, H. Kenneth, layout draftsman, Bendix Products Division, Bendix Aviation Corp., South Bend, Ind.

Hirsch, Robert M., process engineer, Buick Motor Division, General Motors Corp., Melrose Park, Ill.

Kelly, William Austin, liaison engineer, Aircraft Division, Pullman-Standard Car Mfg. Co., Chicago.

Kings, W. J., junior engineer, The Buda Co., Harvey, Ill.

Krueger, George Arthur, engineer, Bell Aircraft Corp., Buffalo, N. Y: Mail: 10130 S. Leavitt St., Chicago.

Perry, D. H., inspector in charge, U. S. Army Air Forces, Dodge Chicago Plant, Chicago.

Townsend, F. Lee, sales engineer, Wm. W. Nugent & Co., Inc., Chicago.

Wallace, Abe R., instructor, Illinois Institute of Technology, Chicago.

Wilson, Richard Wentworth, test engineer, The Buda Co., Harvey, Ill.

Cleveland Section

Allen, Raymond W., engineer, Firestone Tire & Rubber Co., Akron, Ohio.

DeMarinis, Frank, electro chemist, S. K. Wellman Co., Cleveland.

Hackett, Glenn N., purchasing agent, Thompson Aircraft Products Co., Cleveland.

Isabella, Bernard J., assistant project engineer, Thompson Products, Inc., Cleveland.

Keel, Knut O., chief engineer, Cleveland Diesel Engine Division, General Motors Corp., Cleveland.

Keller, Russel J., brake development engineer, B. F. Goodrich Co., Akron, Ohio.

Lee, Walter J., engineer, Goodyear Tire & Rubber Co., Akron, Ohio.

Lisch, Rudolph, chief draftsman, truck division, White Motor Co., Cleveland.

Martin, Stoddard B., owner, S. B. Martin Co., Cleveland.

May, Albert C., vice-president & treasurer, Peerless Automatic Machine Co., Cleveland.

Morse, C. R., associate mechanical engineer, National Advisory Committee for Aeronautics, Cleveland.

Mowery, Robert W., service engineer, S. K. Wellman Co., Cleveland.

Nordstrom, Wilber C., assistant project engineer, Thompson Products, Inc., Cleveland.

Redmond, Gomer H., industrial engineer, Thompson Products, Inc., Cleveland.

Resseger, B. P., field engineer, B. F. Goodrich Co., Akron, Ohio.

Scheucher, Karl, quality engineering, Cleveland Graphite Bronze Co., Cleveland.

Shaw, Daniel Prescott, secretary, manager, Ohio Piston Co., Cleveland.

Speece, Virgil C., truck production engineer, White Motor Co., Cleveland.

Varga, Joseph L., Lester Engineering Co., Cleveland.

Wood, Merrell Arnold, Jr., administration department, Cleveland Diesel Engine Division, General Motors Corp., Cleveland.

Wright, George T., vice-president, Aero Engineering, Inc., Akron, Ohio.

Wurzburger, Paul D., engineer, Weatherhead Co., Cleveland.

Dayton Section

Blanchard, Wallace, Jr., junior test engineer, Aeroproducts Division, General Motors Corp., Dayton.

Camping, Robert Lewis, project engineer, Aeroproducts Division, General Motors Corp., Vandalia, Ohio.

Fultz, H. Edwin, design draftsman, General Machinery Corp., Hamilton, Ohio.

Lommel, Robert George, junior engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Cincinnati, Ohio.

Detroit Section

Avery, Morris G., experimental test engineer, Continental Motors Corp., Detroit.

Boyd, D. A., vice-president, Michigan Leather Products Co., Detroit.

Campbell, J. F., chief engineer, Holley Carburetor Co., Detroit.

Chick, Wilfred J., chief inspector and director of X-Ray laboratory, Gar Wood Industries, Inc., Detroit.

Doe, Thomas B., Jr., plant superintendent, F. L. Jacobs Co., Dearborn, Mich.

Duvall, Norman T., senior ordnance engineer, U. S. Army, Tank-Automotive Center, Detroit.

Egginton, Enoch Joseph, fuels and lubricants engineer, U. S. Army. Mail: 93 Seward St., Detroit.

Gilfillan, H. W., engineer, Chrysler Corp., Highland Park, Mich.

Gilmartin, Henry J., sales engineer, Hyatt Bearings Division, General Motors Corp., Detroit.

Haberstump, Alfred H., chief research engineer, Murray Corp. of America, Detroit.

Holley, George M., Jr., engineer, Holley Carburetor Co., Detroit.

Huppert, Willard L., coach technical and claim department supervisor, Yellow Truck & Coach Mfg. Co., Pontiac, Mich.

Johnson, Ralph S., gear calculator, Chevrolet Gear & Axle Division, General Motors Corp., Detroit.

Lundberg, Ted, secretary and assistant sales manager, Lundberg Screw Products Co., Lansing, Mich.

Olson, Elmer, chief engineer, automotive carburetor division, Holley Carburetor Co., Detroit.

Pfundstein, Keith L., research engineer, Ethyl Corp., Detroit.

Robinson, William F., Jr., draftsman, Chevrolet Division, General Motors Corp., Detroit.

Robson, James Joseph, tire development engineer, U. S. Army, Development Branch, Tank-Automotive Center, Detroit.

Seydler, Frank K., technical representative, National Carbon Co., Inc., New York City. Mail: 5754 Somerset, Detroit.

Shepherd, Charles C., assistant laboratory manager, Ethyl Corp., Detroit.

Sing, Danny Yuke, project engineer, Stinson Aircraft, division of Vultee Aircraft, Inc., Wayne, Mich.

Snyder, Silas C., sales engineer, Continental Motors Corp., Detroit.

Thomson, Henry B., project engineer, Hydraulic Coupling Division, American Blower Corp., Detroit.

Wills, Robert Dale, assistant plant engineer, Morse Chain Co., Detroit.

Wyckoff, Paul Wilson, engineer, Chrysler Corp., Detroit.

Indiana Section

Clayton, Harold H., chief engineer, R-B-M Mfg. Co., division of Essex Wire Corp., Logansport, Ind.

Daily, Robert A., storage battery engineer, Delco-Remy Division, General Motors Corp., Muncie, Ind.

Harris, Paul Earl, chief draftsman, The Perfect Circle Co., Hagerstown, Ind.

Kubiniec, Henry E., production superintendent, Propeller Division, Curtiss-Wright Corp., Indianapolis.

Maci, Raymond James, stress analyst, Allison Division, General Motors Corp., Indianapolis.

Wetzel, Clarence M., process engineer, Merz Engineering Co., Indianapolis.

Wimborough, James R., assistant process engineer, The Perfect Circle Co., Hagerstown, Ind.

Kansas City Section

Canatsey, Kary, general manager, Canatsey Electric Mfg. Co., Kansas City.

Platz, Donald Edward, stress analyst, Strickland Aircraft Corp., Topeka, Kansas.

Metropolitan Section

Abbott, Cornelius James, president, Jacobs Aircraft Engine Co., Pottstown, Pa. Mail: 345 Hycliff Terrace, Stamford, Conn.

Cochrane, W. Coyle, Capt., U. S. Army, New York Port of Embarkation, Brooklyn, N. Y.

Cottle, Harry N., Jr., vibration engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Cox, Robert O., purchasing engineer, General Motors Overseas Operations, New York City.

Dennis, Edwin James, assistant sales manager, E. R. Merrill Spring Co., New York City.

Froling, Robert O., project engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Guerke, Ralph M., chief experimental engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Hanser, Harry, owner, Hanser Automotive Products Co., New York City.

Hickenlooper, Gordon Wright, planning engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Hickman, J. Henry, eastern coach service representative, Yellow Truck & Coach Mfg. Co., New York City.

Hoopman, Harold D., junior engineer, Wright Aeronautical Corp., division of Curtiss-Wright Corp., Paterson, N. J.

Irving, William C., Capt., U. S. Army, Headquarters S.O.S. Ordnance Section, APO, New York City.

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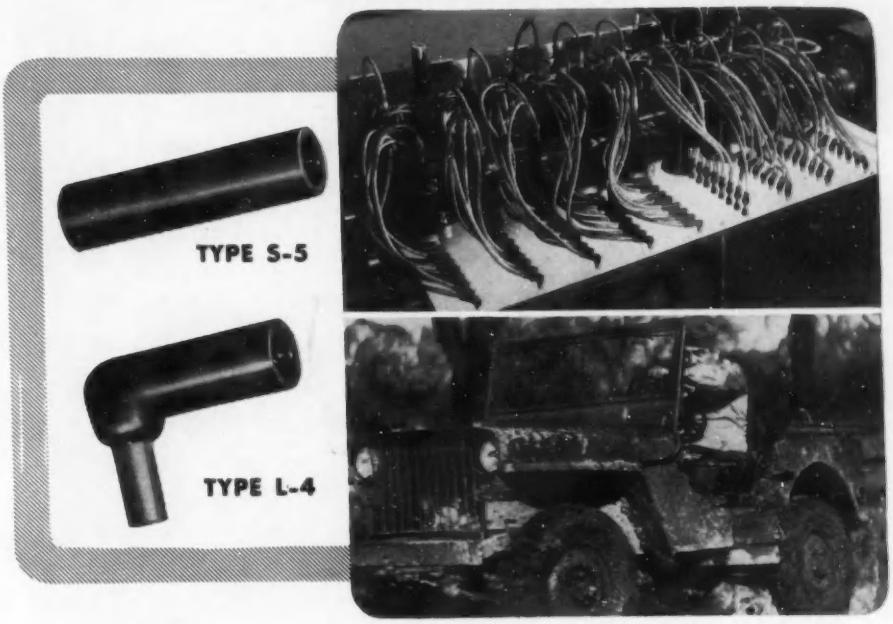

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Marcus, Woodrow C., 1st Lt., U. S. Army, Headquarters Army Air Forces, c/o Postmaster, New York City.

Martin, Joseph F., superintendent of maintenance, American Airlines, Inc., Jackson Heights, N. Y.

McLeod, Fenwick Rodney, production planning supervisor, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

McMacken, Donald C., products application engineer, Shell Oil Co., Inc., New York City.

Roehner, T. G., supervisor, Socony-Vacuum Oil Co., Inc., Brooklyn, N. Y.

Ronayne, Ronald J., test engineer, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

Schaardt, A. F., tool and methods engineer, Dowty Equipment Co., Long Island City, N. Y.

Smith, A. V., vice-president, charge of engineering, Homelite Corp., Port Chester, N. Y.

Snyder, Robert E., hydraulic design supervisor, Simmonds Aerocessories, Inc., New York City.

Warden, Harold H., manager installations department, Propeller Division, Curtiss-Wright Corp., Caldwell, N. J.

van Schmid, Adrien T., service manager, Titeflex Metal Hose Co., Newark, N. J.

Milwaukee Section

Nelson, C. E., president, Nelson Muffler Corp., Stoughton, Wis.

Nevshemal, Raymond A., tractor designer, Allis-Chalmers Mfg. Co., West Allis, Wis.

Perlewitz, Ralph L., McCulloch Engineering Corp., Milwaukee.

Schudt, Harold M., assistant engineer, Allis-Chalmers Mfg. Co., Milwaukee.

Weir, Doris E. (Miss), assistant director of research, Evans Engineering Co., Milwaukee.

Muskegon Group

Kibbey, L. W., production engineer, Sealed Power Corp., Muskegon, Mich.

New England Section

Miller, Robert Oscar, engineer, General Electric Co., Lynn, Mass.

Northwest Section

Harlan, Robert B., Jr., power plant engineer, Boeing Aircraft Co., Seattle, Wash.

Oregon Section

Sheasley, A. W., electrician, Arthur L. Fields Chevrolet Co., Portland.

Peoria Group

Haiss, Paul E., design engineer, Caterpillar Tractor Co., Peoria.

Norris, Fred H., supervisor, Caterpillar Tractor Co., Peoria.

Risk, Norman E., assistant chief engineer, Caterpillar Military Engine Co., Decatur, Ill. Mail: 616 E. Adams St., Morton, Ill.

Shotwell, Daniel B., laboratory engineer, Caterpillar Tractor Co., Peoria.

Philadelphia Section

Frey, George, manager, bus and truck division, Globe Hoist Co., Philadelphia.

Gery, Paul E., assistant chief engineer, Jacobs Aircraft Engine Co., Plant No. 2, Pottstown, Pa.

Horner, Charles R., branch manager, Brockway Motor Co., Inc., Philadelphia.

Lawler, Joseph A., salesman, Price Battery Corp., Hamburg, Pa.

Smith, Marshall C., acting chief engineer, Platt-LePage Aircraft Co., Eddystone, Pa.

Smith, Morgan Garsed, assistant chemical engineer, Gulf Oil Corp., Philadelphia.

Toth, George J., assistant engineer, Jacobs Aircraft Engine Co., Pottstown, Pa.

Tweedale, Joseph T., chief draftsman, Turbo Engineering Corp., Trenton, N. J.

Wollmar, S. F., executive vice-president, S K F Industries, Inc., Philadelphia.

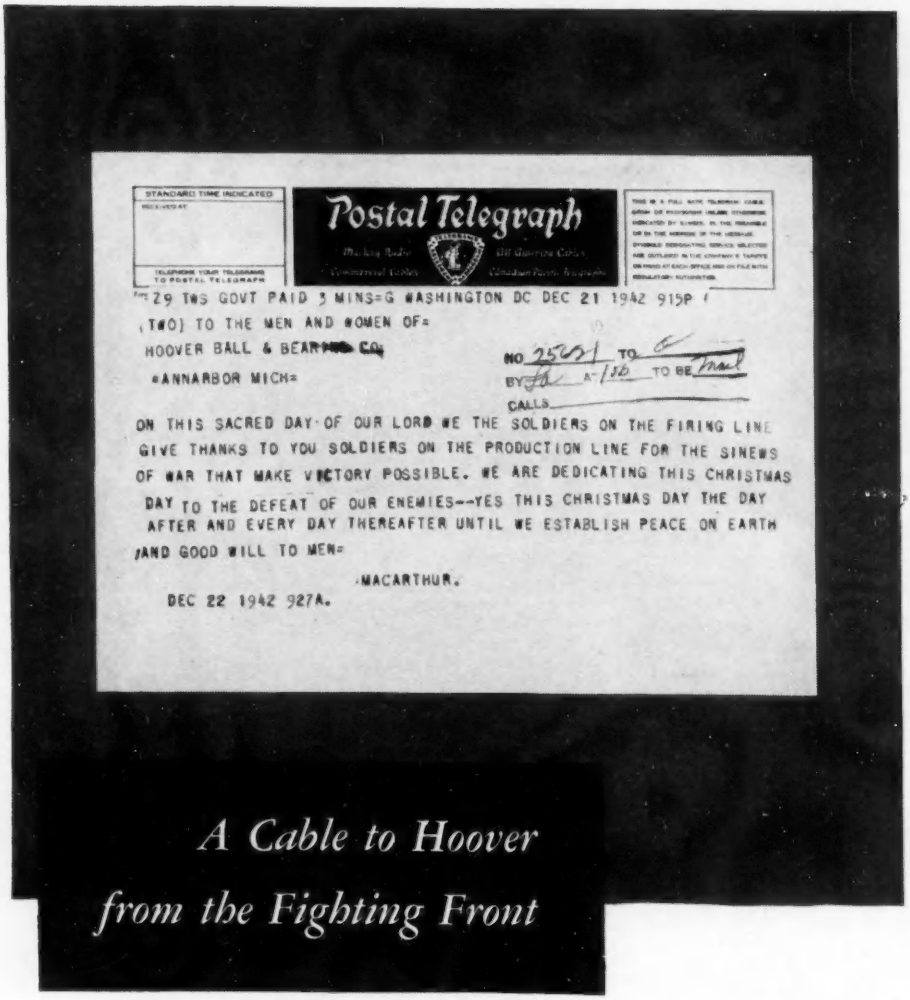
Pittsburgh Section

Bean, Harry P., test engineer, Gulf Research & Development Co., Pittsburgh.

Foist, Millard Fillmore, district manager, Hastings Mfg. Co., Hastings, Mich. Mail: 469 Kenmont, Mt. Lebanon, Pa.

St. Louis Section

Hart, Everett Edmund, aeronautical engineering instructor, Parks Air College, East St. Louis, Ill.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ANNARBOR MICH=
ON THIS SACRED DAY OF OUR LORD WE THE SOLDIERS ON THE FIRING LINE GIVE THANKS TO YOU SOLDIERS ON THE PRODUCTION LINE FOR THE SINEWS OF WAR THAT MAKE VICTORY POSSIBLE. WE ARE DEDICATING THIS CHRISTMAS DAY TO THE DEFEAT OF OUR ENEMIES--YES THIS CHRISTMAS DAY THE DAY AFTER AND EVERY DAY THEREAFTER UNTIL WE ESTABLISH PEACE ON EARTH AND GOOD WILL TO MEN=
MACARTHUR.
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Southern California Section

Adler, Ernest, president, All American Aircraft Products, Inc., Long Beach, Calif.

Allen, Everett S., line inspector, Hartwell Mfg. Co., Los Angeles.

Argo, L. T., owner and manager, Argo Engineering Co., Los Angeles.

Blair, Albert G., assistant to tooling superintendent, Timm Aircraft Corp., Van Nuys, Calif.

Breitenbach, M. J., stress analyst, Consolidated Aircraft Corp., San Diego, Calif.

Bridgland, Edgar Parsons, engineering officer, Royal Canadian Air Force, Mail: 551 S. Hill St., Pasadena, Calif.

Burberick, Stanford V., assistant standards engineer, Hughes Aircraft Co., Culver City, Calif.

Cresse, John Wesley, engineer, Pacific Airmotive, Lockheed Air Terminal, Burbank, Calif.

Drake, Lawrence E., sales engineer, Thompson Products, Inc., Bell, Calif.

Fitch, Raymond L., metallurgical engineer, Western Industrial Engineering Co., Los Angeles.

Fletcher, R. M., field engineer, Titeflex Metal Hose Co., Newark, N. J. Mail: 3863 Carnavon Way, Los Angeles.

Fox, Orrin T., Capt., U. S. Army, 49th Field Artillery Battalion, Camp San Luis Obispo, San Luis Obispo, Calif.

Freeman, Eugene John, engineer, Adel Precision Products Corp., Burbank, Calif.

Geddes, Robert P., Jr., liaison engineer, American Amplifier & Telephone Co., Inc., Los Angeles.

Gilliland, Edwin G., automotive advisor, U. S. Army, Automotive Office 94, 7th Division, APO No. 7, Camp San Luis Obispo, San Luis Obispo, Calif.

Jones, David R., engineering assistant, Vega Aircraft Corp., Burbank, Calif.

Josephson, Raydelle I., engineer, Aireserach Mfg. Co., Los Angeles.

Linton, Tom B., chief engineer, Buchanan Mfg. Co., Burbank, Calif.

Martin, Myron M., superintendent, owner, Martin Supply Co., N. Hollywood, Calif.

Oldmore, Arthur B., layout engineer, Adel Precision Products Corp., Burbank, Calif.

Perry, Wilbur T., chief draftsman, Plant No. 2, Kinner Motors, Inc., Glendale, Calif.

Ressler, Paul H., automotive advisor, U. S. Army, Camp San Luis Obispo, San Luis Obispo, Calif.

Rice, Frederick Henry, production illustrator, Adel Precision Products Corp., Burbank, Calif.

Sargent, Earl A., inspector, Vega Aircraft Corp., Burbank, Calif.

Shambrook, George D., battalion motor officer, U. S. Army, 31st Field Artillery Battalion, Camp San Luis Obispo, San Luis Obispo, Calif.

Sundt, E. V., president, Littelfuse Incorporated, El Monte, Calif.

Tracy, Paul Wilcox, layout draftsman, Vega Aircraft Corp., Burbank, Calif.

von Seggern, Ernest, vice-president, engineer, von Seggern Engineering Corp., Escondido, Calif.

von Seggern, Henry, president, engineer, von Seggern Engineering Corp., Escondido, Calif.

White, William Harris, Jr., aeronautical assistant research engineer, Vega Aircraft Corp., Burbank, Calif.

Zilz, Gerald J., chief liaison engineer, Northrop Aircraft, Inc., Hawthorne, Calif.

Southern New England Section

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Syracuse Section

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Space, Charles B., chief engineer, clutch division, Lipe-Rollway Corp., Syracuse.

Texas Section

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Haddaway, George Edward, editor and president, *Southern Flight,* Dallas.

Mattison, John Heywood, Guiberson Diesel Engine Co., Dallas.

Simpson, John G., Major, U. S. Army, staff officer, in charge of maintenance, II Air Service Area Command, Fort Worth, Texas.

Washington Section

Cullen, Marion W., associate engineer, U. S. Army, Ordnance Department, Washington, D. C.

Fielding, Fred H., branch manager, The Heil Co., Washington, D. C.

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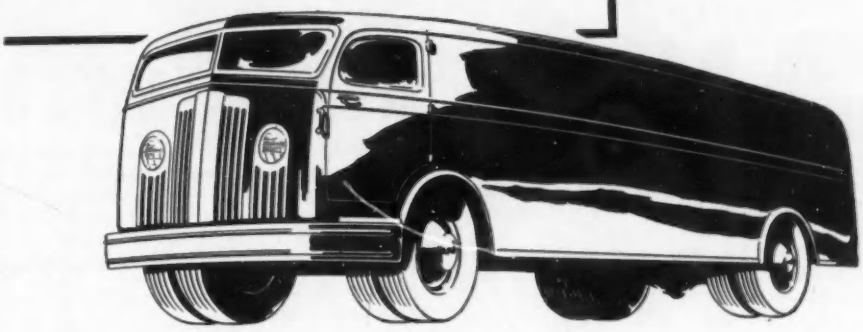

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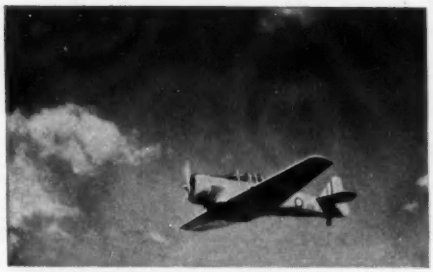
Quick, Kenneth Page, 1st Lt., U. S. Army, Q.M. Office, Fort Washington, Md.

Witherow, Charles William, assistant service manager, Briggs Clarifier Co., Washington, D. C.

Wichita Section

Hackett, Virgil W., chief draftsman, Cessna Aircraft Co., Wichita.



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Laurance, Edwin N., general superintendent, Intercontinent Corp., Miami, Fla.

Lentz, Eugene Garland, hangar foreman, Lycoming Division, The Aviation Corp., Williamsport, Pa.

Lindamood, Warren N., manager, Webb Oil Co., Minneapolis, Minn.

Mills, Robert Taylor, sales executive, Mills-Morris Co., Memphis, Tenn.

Monroe, Carl O., junior instructor, U. S. Army Air Forces Technical School, Lincoln, Nebr.

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Hambling, Stewart Kevern, senior research engineer, Shell Refining & Marketing Co., Chester, England.

Harvey, Alfred, designer, Vickers-Armstrongs, Ltd., Surrey, England.

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Morrison, Alfred Charles, consulting engineer, Department of Scientific Research, British Government, England.

Perrett, John Bertram, designer, engine and transmission section, Vickers-Armstrongs, Ltd., Surrey, England.

Russell, L. B., senior draftsman, John I. Thornycroft & Co., Ltd., Basingstoke, Hants, England.

Whitfield, Ernest Oswald, senior technical assistant, Ministry of Supply, Adelphi, London, England.

Joseph, Peter, maintenance engineer of launches, Alcoa Steamship Co., Inc., Port of Spain, Trinidad, B.W.I.

NEW MEMBERS Qualified

These applicants who have qualified for admission to the Society have been welcomed into membership between Dec. 15, 1942, and Jan. 15, 1943.

The various grades of membership are indicated by: (M) Member; (A) Associate Member; (J) Junior; (Aff.) Affiliate Member; (SM) Service Member; (FM) Foreign Member.

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Simpson, Ernest Leslie (M) department head, Ford Motor Co. of Canada, Ltd., Windsor, Ont.

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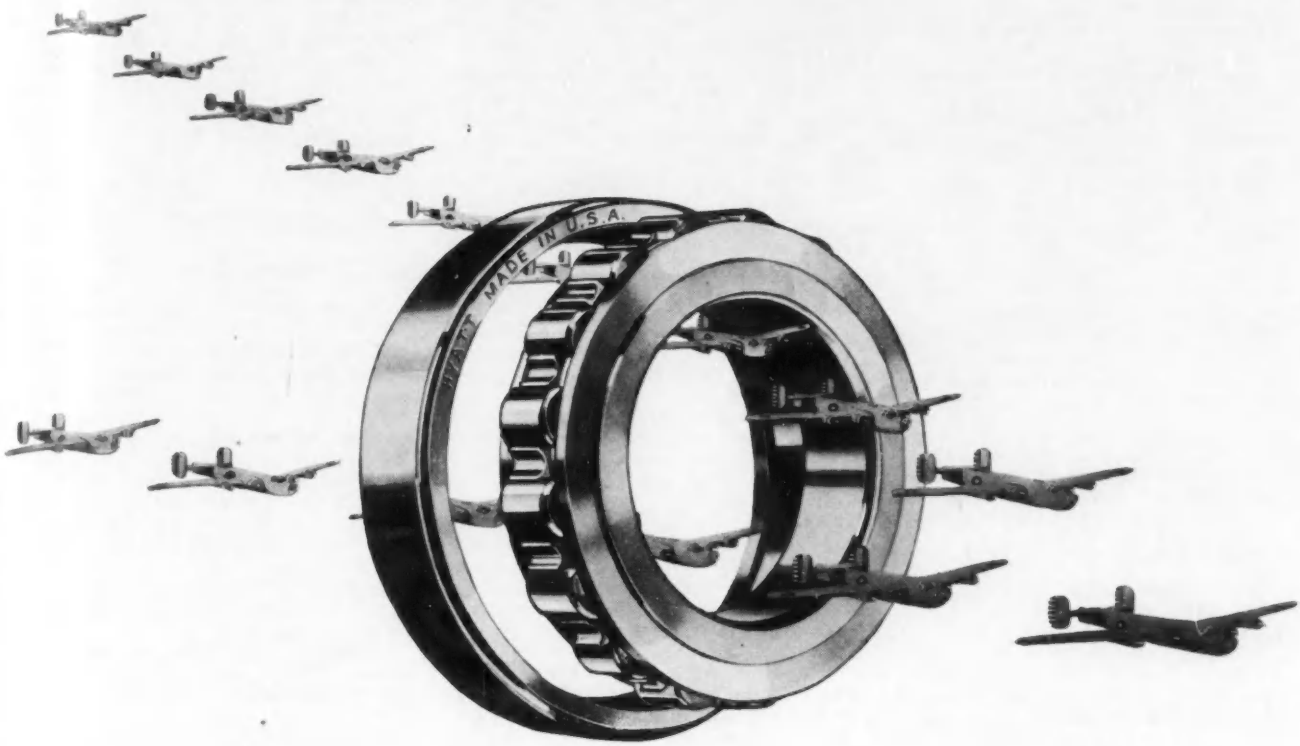
Koss, Victor T. (J) draftsman, Jack & Heintz, Inc., Solon Rd., Bedford, Ohio (mail) 8812 Tompkins Ave., Cleveland.



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